THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXIV. No. 1641.] LONDON, OCTOBER 23, 1894. [46TH YEAR. PRICE 6d.

JAMES OAKES & Co.,
ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road,
CITY ROAD, LONDON, N.,

Manufacture and keep in Stock at their Works (also large stock in London)

PIPES and CONNECTIONS, 1½ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts and covers, and rendering leakage impossible.

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TORBAY PAINTS
Special Quotations to Gas Companies.
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LIMITED.
LANEMARK CANNEL
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NEW CUMNOCK, N.B.
Shipping Ports: All the principal Scotch Ports.

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Manufacturing Gas Engineers.

See Advt. p. 799 of this week's Issue.

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FOR TOWN WATER-WORKS AND OTHER SUPPLIES.
The following Town Water-Works Supplies have been obtained by this System, viz.:—Abbott's Langley, Aldershot, Alnwick, Cirencester, Hertford, Lechlade, St. Albans, Shrewsbury, Skegness, Southampton, Stony Stratford, Swansea, Wallingford, Watford, West Worthing, Wimborne, &c.
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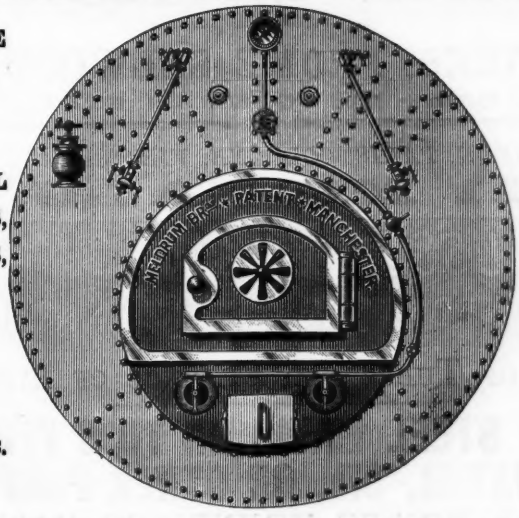

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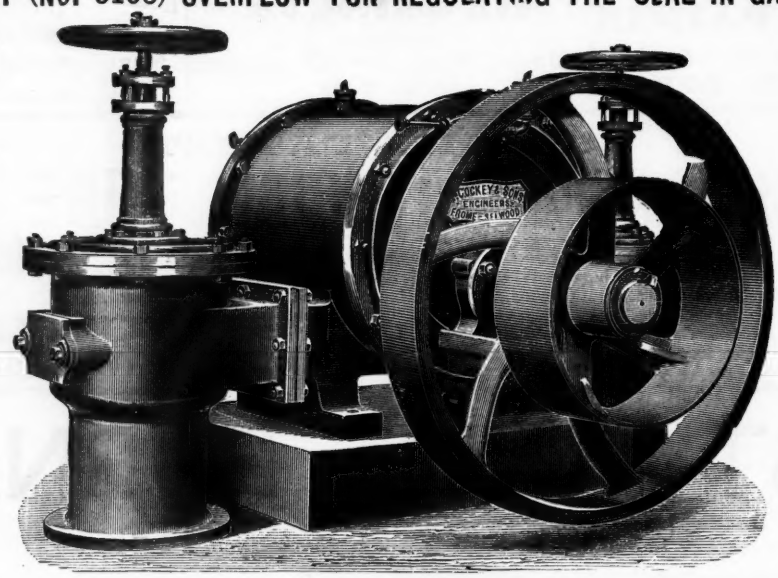

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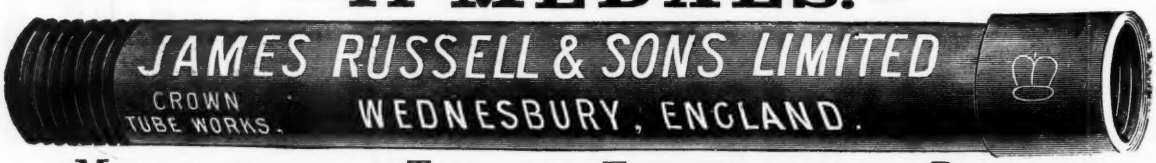

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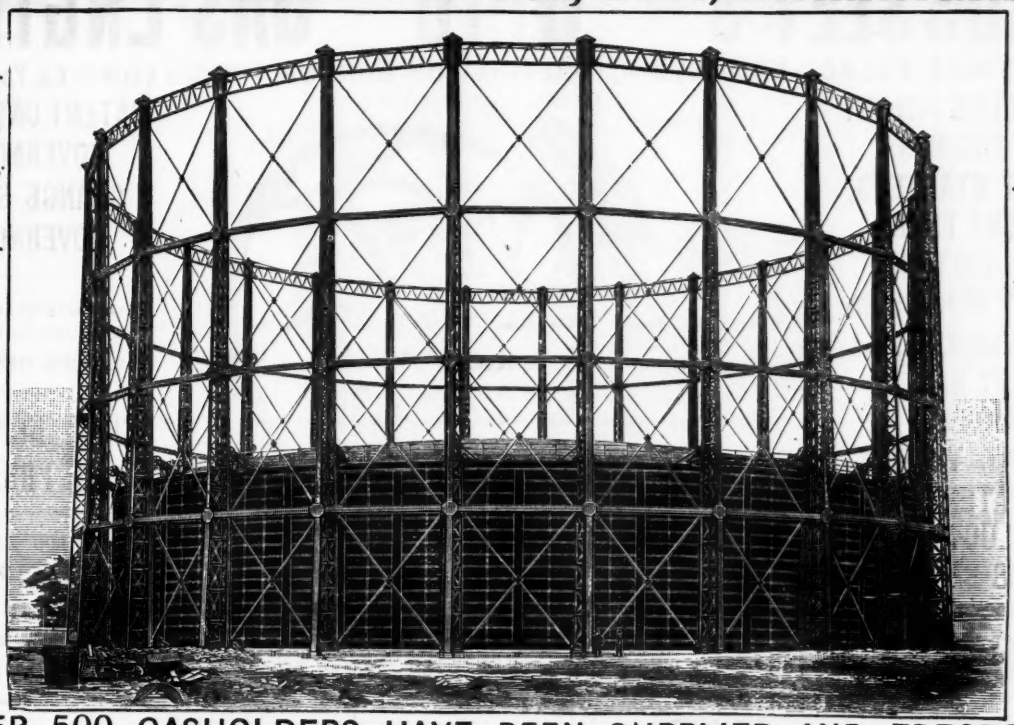

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SCRUBBERS, & WASHERS,

TAR AND LIQUOR PUMPS, &c.

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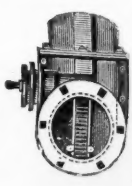
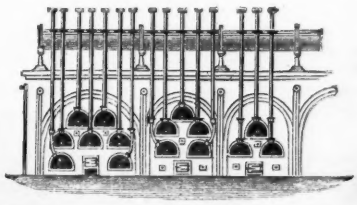
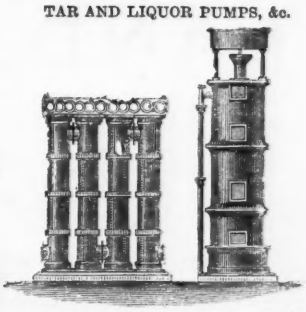
CENTRE-VALVES

for working Purifiers,

Also Bye-Pass & Stop Valves







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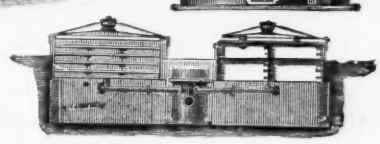

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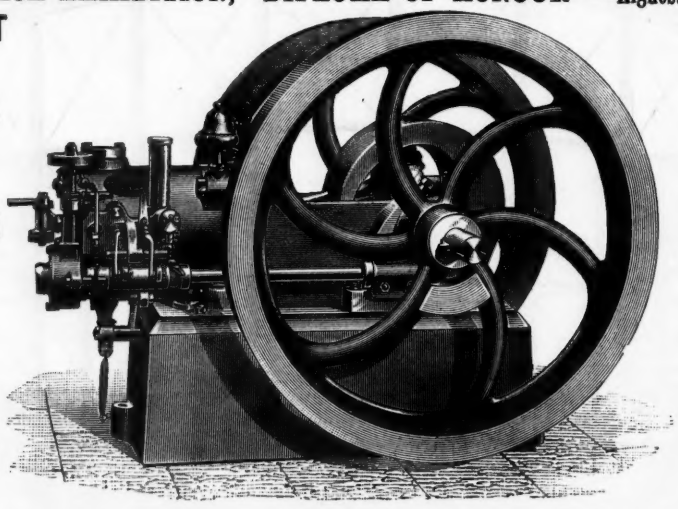

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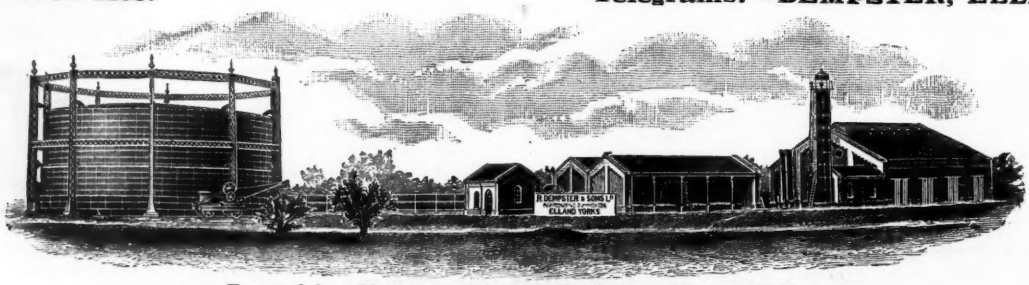

Engraved from Photograph of Complete Works erected by us in 1893.

The whole of the Apparatus, Foundations, Retort-Work, Buildings, and Levelling of Site have been executed by our men, without Sub-Contracts.

Estimates and Illustrations for complete Works, or for any detailed parts, supplied gratis on application.

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PURIFYING-MACHINES FOR AMMONIA.

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TAR PLANT.

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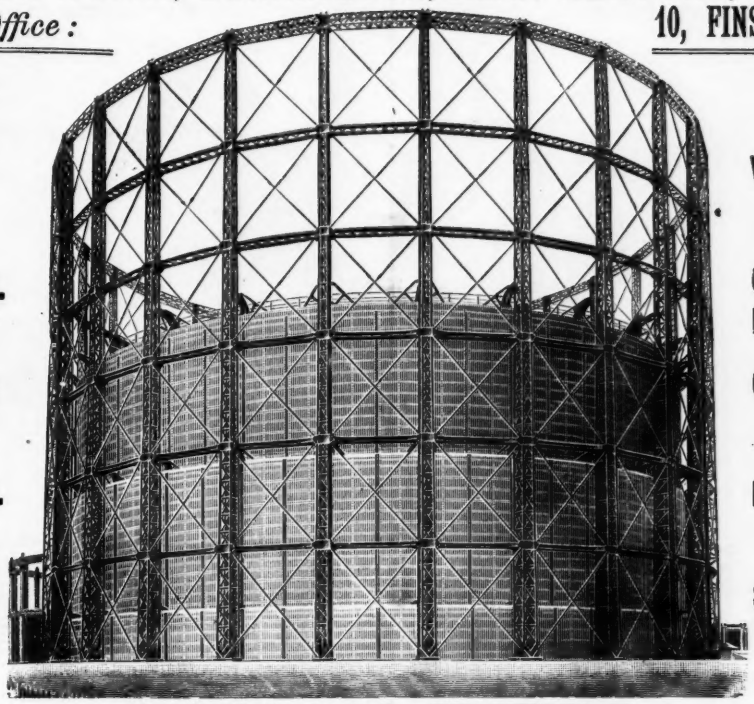

GASHOLDERS.

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WASHER-SCRUBBERS.

CLAUS' SULPHUR-RECOVERY PLANT.

CENTRE & FOUR-WAY VALVES.

RETORT-MOUTHPIECES.

SLIDE-VALVES, TAR-BURNERS, SIEVES, &c., &c., &c.

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TO GAS COMPANIES, CORPORATIONS, AND VESTRIES.

IMPROVED STREET LIGHTING,

WITHOUT ADDITIONAL COST,

With THREE to FOUR TIMES the ORDINARY LIGHT,

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THE INCANDESCENT GAS-LIGHT (Welsbach System),

WHICH HAS NOW BEEN ADAPTED TO

STREET LIGHTING,

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THE "KENT."

With Nickel-Plated Trivet.

Size: 29 in. high, 22 in. wide. Fire 11 in. wide.
Ground and Berlin Blacked, with Tiles or Cast Side Panels as shown.
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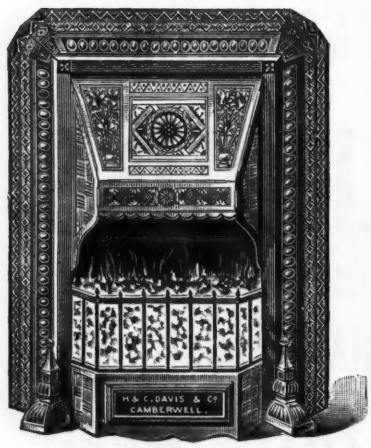
Ditto, ditto, with Bronzed or Brassed Top Panels, Mouldings, Side Plinths, Pillars, and Canopy. Price £6 6s.

The "L.S.N." 1 & 2.



L.S.N. 1. Size: 20½ in. high, 18½ in. wide.
Price . . . . . £1 4s.
Electro Bronzed or Brassed.
Price . . . . . £2 5s.
L.S.N. 2. Size: 24½ in. high, 20½ in. wide.
Price . . . . . £1 15s.
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Price . . . . . £3.
Tiled Fender, 5/- extra. Elbow, 1/6 extra.
Nickel Plated Trivet, 1/- extra.

The "BEDFORD."

15 in. high, 12 in. wide.
Fire space, 10 in.
PRICE, with Trivet complete,
Berlin Blacked 12/6
Blue Black Enamelled 17/6
Electro Brassed or Bronzed . . 25/-
Nickel Plated Trivet, 1/- extra.

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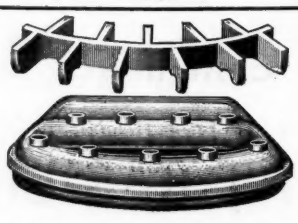
Size:
18½ in. high, 14⅜ in. wide, 5¼ in. deep.
12 in. Fire Space.
Price 17/6

The "H." Fire.

It is constructed with fancy Tiles in Top Panels and polished Trivet, 22 in. high, 16½ in. wide. 6 in. deep. Fire 12 in. wide.
Fine Cast and Blacked, with polished Trivet, £1 2 6
Electro Brassed or Bronzed, £2 5 0
If fitted with Patent Trident Burner . . . £1 5 0
Electro Brassed or Bronzed, £2 7 6
Elbow, 1/6 extra. Nickel Plated Trivet, 1/- extra.

"S.G.B." BURNER (Patented).

Sizes.	Price.
8 inches	4/6 each.
10 „	5/6 „
12 „	6/6 „
14 „	7/6 „



This Burner has been specially designed for use with ordinary Register Stoves. It is silent in action and moderate in Gas consumption, and can be readily fitted to any existing Register Stove with Grate Bottom.

Special Fire-Brick for economizing Gas and increasing radiation of Heat: 8 in., 1/3; 10 in., 1/6; 12 in., 2/-; 14 in., 2/6.

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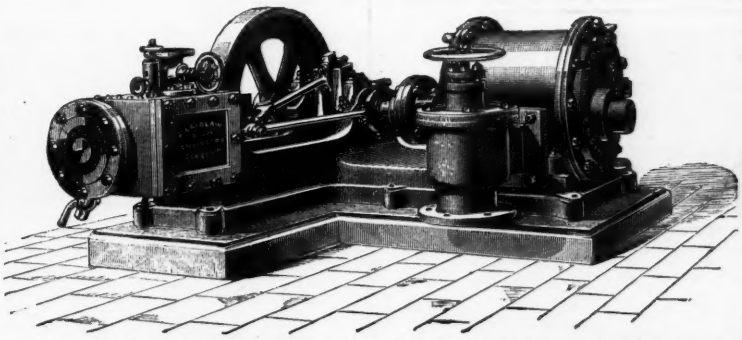
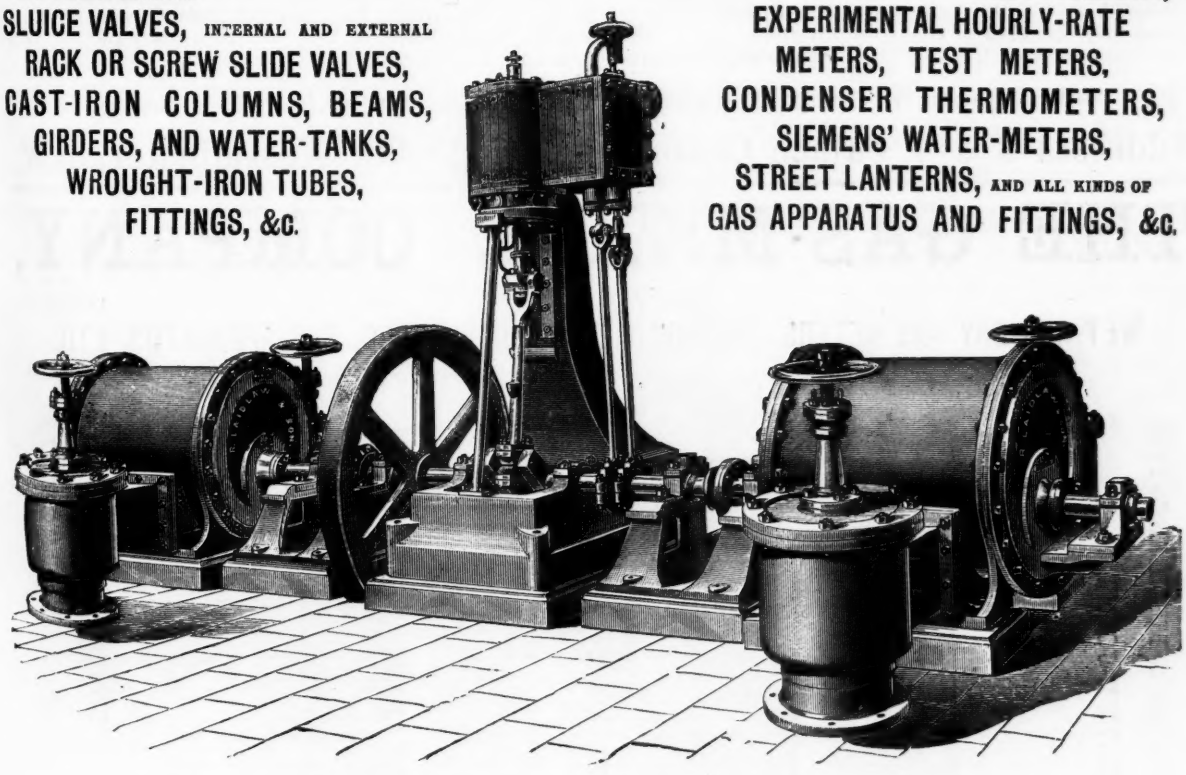
STEAM-ENGINES AND BOILERS,
PUMPING-ENGINES For Water-Works.
BEALE'S GAS EXHAUSTERS,
DOUBLE-FACED SLUICE VALVES, INTERNAL AND EXTERNAL
RACK OR SCREW SLIDE VALVES,
CAST-IRON COLUMNS, BEAMS, GIRDERS, AND WATER-TANKS,
WROUGHT-IRON TUBES,
FITTINGS, &c.



BEALE'S GAS EXHAUSTER AND ENGINE COMBINED. All Sizes.

Makers in Edinburgh of
WET AND DRY GAS-METERS, IMPROVED
STATION GOVERNORS,
PRESSURE REGISTERS
PRESSURE GAUGES,
TEST HOLDERS,
EXPERIMENTAL HOURLY-RATE METERS, TEST METERS,
CONDENSER THERMOMETERS,
SIEMENS' WATER-METERS,
STREET LANTERNS, AND ALL KINDS OF
GAS APPARATUS AND FITTINGS, &c.



BEALE'S GAS EXHAUSTERS AND ENGINE COMBINED. All Sizes.

Prices, with full Particulars, will be given on application.

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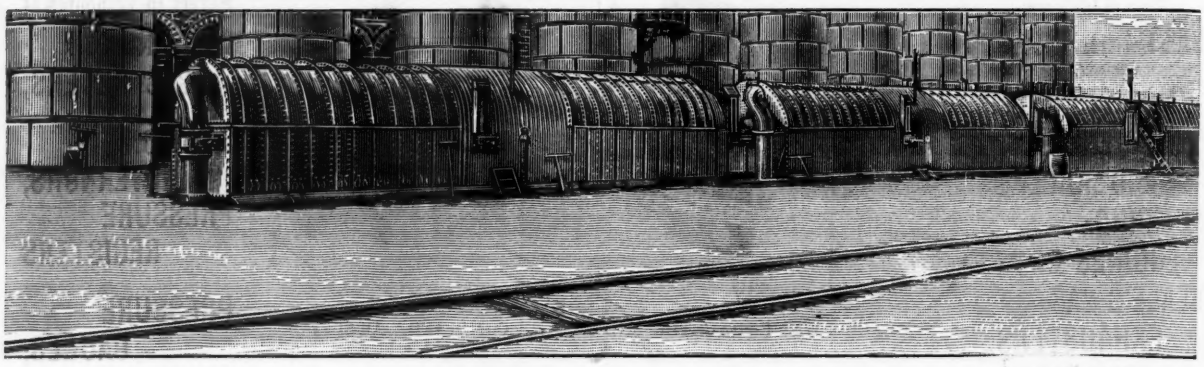
PATENT "STANDARD" WASHER-SCRUBBER.

☞ **483** of these Machines (capable of dealing with **464,340,000** cubic feet of Gas daily) in use, which fact is given as evidence of this apparatus being the Most Efficient of any in the Market for the extraction of Ammonia, Carbonic Acid, and Sulphuretted Hydrogen from Coal Gas.



View of SIX PATENT "STANDARD" WASHER-SCRUBBERS, erected at the Beckton Station of The Gaslight and Coke Company (the Engines driving same being under Galvanized Iron Covers). This Company has **30** of these Machines in use. They are also in operation at a great number of Gas and other Works in this Country and abroad.

Sole Agents in Great Britain for Marshall's Patent Tar Extractor.

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SQUARE STATION METERS WITH PLANED JOINTS.

STATION METERS IN CYLINDRICAL CASES.

DESIGN No. 2 PATTERN.

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INCORPORATED IN
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WORTLEY, LEEDS.

LONDON OFFICES & DEPÔTS:
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WHARVES NOS. 2 & 4, INSIDE G.N. GOODS YARD, KING'S CROSS, N.
LIVERPOOL:
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MACHINE-MADE RETORTS

Have been made in large quantities for the last twelve years; and during the whole of that time, have been in regular use at most of the largest Gas-Works in the Kingdom. They possess the excellent quality of remaining as near stationary as possible under the varying conditions of their work—a quality which will be appreciated by all Gas Engineers and Managers. The generally expressed opinion is that these Retorts are the very best that are made.

RETORTS CAREFULLY PACKED FOR EXPORT.

Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.

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J. & H. ROBUS,

ENGINEERS & CONTRACTORS,
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furnish Plans, Estimates, and Specifications for SINKING BOREHOLES *and* WELLS; *Erecting* RESERVOIRS, FILTER-BEDS, *and* GASHOLDER TANKS; *and* EVERY REQUISITE *for* GAS *and* WATER WORKS,

INCLUDING

MAIN LAYING

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ALDWARKE MAIN CAR HOUSE & ROTHERHAM MAIN COLLIERIES, NEAR ROTHERHAM.

ALDWARKE MAIN GAS COAL

Analysis: 12,600 feet of 19-candle gas per ton.
Weight of illuminating power in pounds of sperm, 820·80. Very free from impurities.
Telegrams: "ATLAS SHEFFIELD."

AN APPARATUS WHICH PERFORMS THE COMBINED DUTIES OF

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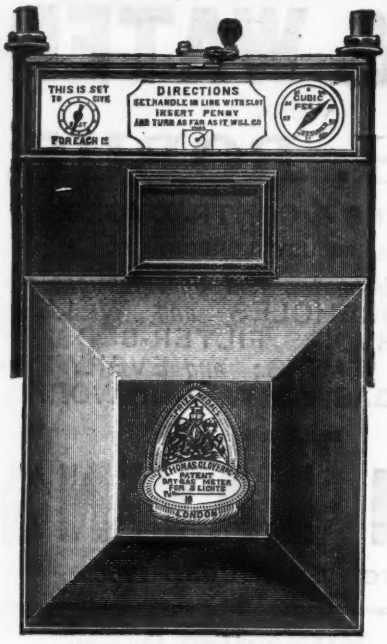

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TO CORRESPONDENTS.

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THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, OCTOBER 23, 1894.

Portable Gaslight.

THE offer of a correspondent in the present issue of the JOURNAL to discuss the question of supplying gas in cylinders under pressure, instead of through the medium of "the costly and cumbersome gasholders now in vogue," arouses reflections that go back to the days of "portable gaslight." It is, at the first blush, an interesting example of the tendency of history to repeat itself in respect of gas supply, as in other mundane affairs. Although history offers to do so in this particular respect, however, like all such repetitions it is with a difference. When, in the early days of the industry, the problem of distribution was attacked by the two methods of portable supplies and canalization, the respective advantages and defects of these rival methods were not quite the same as those of which a comparative examination of the same systems would now have to take account. The latest writer to review the old systems of gas distribution—M. Maréchal—pertinently observes that in those times the question of delivering gas in portable reservoirs, or by means of a staunch pipe-line, might well be resolved in favour of the former, seeing that the canalizations of the period were very defective, and were only developed very slowly. Portable gas was just the thing for the scattered consumers of the early part of the century; but it was soon recognized that the cost of carriage could only be borne by a very rich gas, which was specially made for the purpose from oils. This was delivered in varnished canvas bags, borne upon large vans; and the gas was caused to pass into the consumers' service holders by squeezing the bags by means of a winch. The method had eventually to be abandoned, on account of the excessive price of the raw materials for gas making, the costly carriage due to the gas having to be conveyed in low-pressure reservoirs, and to troubles with the bags. M. d'Hurcourt, and after him M. Hugon, perceived that it would be more economical to make gas from cannel when intended for delivery in the portable form, and to compress this gas strongly in cylindrical iron vessels, capable of being easily stacked and carried in vans. It may surprise our readers and correspondents to learn that this business is actually carried on in Paris.

This interesting survival has head-quarters at No. 104, Rue de Charonne. Its commercial importance has naturally suffered since nearly all the streets of Paris were provided with gas-mains. But even in Paris it still supplies a few consumers. Its customers are chiefly to be found in the suburban communes, particularly in such as have no gas-works. Yet the factory also supplies gas for distribution through certain small networks of mains. Those at Marly, for instance, are fed from reservoirs of compressed gas kept regularly supplied by the vans from the establishment in the Rue de Charonne. M. Maréchal gives particulars of this factory, which produces cannel gas by the ordinary method of carbonization, to be afterwards compressed under a pressure of 11 atmospheres, and so delivered directly into the cylinders piled to the number of nine in each van. Some of these vans are always in waiting; and the cylinders constitute the only gasholder. The consumer has his own service cylinder, which delivers the gas through a pressure-reducing valve. It sells for 1 fr. per cubic mètre, or about 22s. 6d. per 1000 cubic feet; and being reckoned at 3½ times the illuminating power of the gas supplied by the Paris Gas Company—surely a very generous estimate—the consumers regard it as quite as cheap as the latter.

There can be no doubt that, for certain consumers, portable gas is calculated to provide a cheap and satisfactory means of lighting. There is no reason why a house, or even a group of houses, should not be as suitable for the application of this system as a railway coach. Nevertheless, it is a branch of business that has been overlooked everywhere, so far as we know, with the solitary exception of the Hugon establishment in Paris, the existence of which is known to few. It may not be easy to define off-hand the conditions under which portable gaslight would be found to pay and would find a market; but that such conditions obtain and are to be satisfied, the continued existence of the Hugon establishment is sufficient proof.

A Libel on the Incandescent Gas-Burner.

THAT our friends of the electric lighting interest should be disgusted at the phenomenon of the growing popularity of the incandescent gas-burner, is only what might be expected in the circumstances. This striking way of lighting by gas is no longer a novelty; but it is well known that until recently the commercial development of the system has been hindered by several obstacles, which now appear to have been removed, with the result that the present managers of the Welsbach lamp business are pushing it with much energy. It is impossible to blame them for this, especially as much valuable time has been lost; and time, in connection with the exploitation of a patented article of trade, is very emphatically money. The sight of the huge newspaper advertisements of the Incandescent

Gas-Light Company has, however, been too much for the *Electrical Review*, which has accordingly endeavoured to discredit the claims advanced on behalf of the Company's specialty by criticizing their published testimonials in a spirit that cannot be called gracious on the part of the supporters of another industry for which advertisement has done so much, and "French measurement" has done even more. As our contemporary has been fair enough to publish the letter which we reproduce elsewhere in support of the claims of the Welsbach light to economy and efficiency, it is altogether unnecessary for us to advance anything further upon these heads. It appears, however, that what the *Electrical Review* most dislikes in the incandescent gas-burner is its alleged unhealthiness. It is not that the cheapness and brilliancy of incandescent gas lighting alarm those who pin their fortunes to the incandescent electric lamp; but the former is suspected of being guilty of polluting with carbon monoxide—"carbonic mon-oxide," our friends call it—the atmosphere of apartments where it is used; with which, of course, solicitude for the public health forbids them to abide. Hence our contemporary would "call the attention of "persons interested in public buildings to this matter, as "it is one that affects them closely." The source of these alarms is the first communication of M. Gréhant to the *Comptes Rendus* on the products of combustion of gas burnt in an Argand and also in an incandescent burner, which some French newspaper pounced upon, and quoted with the same gusto that the journalists of that polite nation display in disparaging anything and everything bearing a German name. This version of M. Gréhant's incomplete and inconclusive researches was noticed by a Frankfort journal, whence it was taken for gospel by the *Electrical Review*. Meanwhile, we published a special translation of M. Gréhant's "Note" in our issue for the 4th ult., adding to it—which our contemporaries do not seem to have done—a further communication from the same author materially correcting, even to the point of contradicting, his first conclusions in regard to the unhealthiness of the incandescent gas-burner. His later experiment was described in the *Comptes Rendus* for July 30 last; and, in regard to it, M. Gréhant said: "Je conclus de cette expérience que *l'emploi d'un bec Auer ne peut pas produire d'empoisonnement*"—the italics being the author's.

We have no particular desire to befriend the Incandescent Gas-Light Company; and, indeed, we do not suppose the principle of gas lighting, of which their patented system is the best actual embodiment, will perform all the service to the industry that may be expected of it until after the expiration of the Welsbach patents. But when a meritorious gas apparatus is unjustly condemned as unfit for public use, it is our place to defend it so far as obligation to tell the truth allows. In this case, common prudence should have warned a fair-minded critic against relying, in such an important matter, upon the unsupported statement of a single experimenter, who, with the rashness too frequently exhibited by French men of science, hurried off to the Académie his account of the unverified results of his one experiment, only to have to confess his error a few days later. Here again the saying that if once a lie is given a start it is impossible to overtake it, has been exemplified. If we desired to be unkind to the electricians, we might talk about nitric-acid-producing arc lights more properly than they can about the production of carbon monoxide by incandescent gas-burners. But the subject may perhaps be now left where it stands, with the remark that it will take more than one Frenchman, and more than a single experiment, to satisfy impartial people with their wits about them that carbon monoxide is a constant product, in appreciable bulk, of the consumption of coal gas in the incandescent burner.

Suspected Trade Union Outrages at the Plymouth Gas-Works.

As will be seen from the report which appears in another column, the recent introduction of carbonizing and labour-saving machinery into the Plymouth Gas-Works has been resented by the commission of a number of acts of reprisal which recall the performances of the Broadhead gang in Sheffield. The discharge of thirty men belonging to the Gas Workers' Union is thought to be connected with these outrages, which were of a kind that strongly suggest skilled direction. It cannot have been a stranger to the methods of gas manufacture (and improved methods at that) who directed the operations described in our report, which might well have wrecked a gasholder, as they actually succeeded in putting a whole district of the town, including two railway stations, in total darkness for a short time last Thursday night. Police protection has been called in to guard the more vulnerable parts of the works and plant, and a reward of £100 has been offered by the Directors for the discovery of the guilty parties. It is to be hoped, however, that by this time a sense of the futility of this line of conduct has been borne in upon the consciousness of whoever counselled it; but, if not, and fresh outrages are attempted, the only course open to the Directors will be to clear out the whole of the present working staff who can be reasonably regarded as causing or consenting to such nefarious proceedings. That anything of the kind should have been set on foot is a warning to all those who may have entertained the amiable delusion that the methods of industrial conflict had been purged of the anarchical element. It is not to be supposed that the leaders of the Gas Workers' Union, in Plymouth or elsewhere, will either avow or be easily convicted of having had a hand or a voice in causing these attempts upon life and property—for they are nothing else; but there is no difficulty in assigning them to the persistence among a certain section of the community of that spirit of defiance to the rule of law, order, and progress which must be kept in subjection, and if possible stamped out, if civilization is to be preserved in the land. If Trade Unionism is the harbour for such a spirit, then so much the worse for Trade Unionism. There is nothing at all vindictive in this declaration, which is no more than a simple statement of the conditions under which the industrial, like every other department of modern life, has to be carried on.

The Silent Standards of Light Committee.

TIME slips by; and still the Board of Trade Committee on Standards of Light for use in the photometry of London gas "makes no sign." Whether or not, like the gentleman in the play in connection with whom *this* phrase was originally used, death is to supervene before any movement of the kind is made, remains to be seen. Art is long, and time is fleeting; and there are some members of this particularly leisurely Committee whose interest in the subject of this inquiry will terminate by natural process if the job hangs much longer on hand. The circumstance of the labours of the Committee being gratuitous absolves the members from an obvious suspicion of motive which might otherwise have been entertained; but it is high time that these exemplars of the Great Unpaid should realize that there is a limit to the forbearance which a long-suffering technical world extends to those who volunteer to do its business. What is the particular slough in which the Committee are stuck? Is it a question of nomenclature, a question of fact, or a personal question? Meanwhile, the Committee are running the risk of appearing supremely useless, barren, and disappointing. If they know what a candle is, and how the light of gas may best be measured by a candle unit, why do they not say as much, and have done with it? The suspicion is abroad, and is growing, that the appointment of the Committee will turn out to be a complete *fiasco;* and nothing less than the publication of their long-expected report will redeem the reputation of the members of this extraordinarily reticent body for common business aptitude, to say nothing of diligence. If they have made a mess of their commission, the straightforward course will be for them to confess as much, throw it up, and ask the Board of Trade to appoint in their stead a more practical set of investigators, who can be trusted to make up their minds on the matter at issue in something less than the lifetime of a Patriarch.

The Salford Corporation Finances.

A FORTNIGHT ago we referred in these columns to the occurrence of a large deficit in the Salford Corporation finances; remarking that while the fact of there being a loss of about £70,000 was admitted, no explanation was offered of the manner in which this had been brought about, or who was responsible for it. It is with considerable gratification that we are now able to state, upon the authority of the Mayor (Sir W. H. Bailey), who mentioned the matter at last week's meeting of the Town Council, that there is no deficiency in the Corporation accounts, and no money lost. What has happened is merely the very ordinary circumstance of the Corporation having overdrawn on their banking account, and an excess of

expenditure by the various spending Committees of the Corporation over the authorized estimates. Practically, therefore, nothing that can properly be described as a Corporation scandal has arisen in this connection; and nothing would have been publicly known of the matter, but for the excess of expenditure having attained somewhat startling proportions, and also for the local habit of "washing all the Corporation dirty linen in public." While gladly giving prominence to Sir W. H. Bailey's very reassuring statement, however, we do not desire to withdraw or even to qualify in the slightest degree the strictures we have passed upon the course which the Corporation have thought fit to take for replenishing their till. Whether the ratepayers' money has been squandered or stolen is immaterial in regard to the immediate effect of the action of the Corporation upon their gas undertaking and their other sources of supplemental revenue. The local gas supply was never confided to the care of the Corporation with a view to its being raided whenever, for any reason, the municipal coffers run short of cash. The same may be said of the plunder gathered in by the Corporation under the Local Taxation (Customs and Excise) Act, 1892. This additional source of revenue which, by a mere "fluke" in the political game played at Westminster, fell into the hands of local authorities throughout the country, was intended to be applied in aid of Technical Education. The time will arrive when an inquiry will be held into the working of this Act, and its results. Meanwhile, some of the Salford portion of the funds raised under it might be devoted to the technical education of members of the Town Council in their duty to the community, and especially to the consumers of gas.

Lessons of the Scotch Miners' Strike.

THE lessons of the Scotch miners' strike have been plainly pointed out in a recent letter published in the *Engineer* over the signature "Greta Bridge." They are well worth the attention of workers in all trades. The writer shows, to begin with, that the strike was very ill-timed. It could only have succeeded if it had been in the power of the colliery proprietors to force up the price of coal; "but this could not "possibly be done while the iron and other trades were so "bad." Moreover, the strike was, as our Scotch Correspondent remarked last week, "foolishly conceived and "stupidly worked." It is necessary to rub these points in when a strike fails, because at such times the agitators and their newspaper supporters always run away and keep strict silence respecting the consequences of their own bad counsels. Our contemporary's correspondent shows that the quality of the miners' leaders is rapidly deteriorating. Time was when hard-handed were led by hard-headed men; but now the leaders who make so much noise and do so much mischief in the industrial world are "simply and "only blatant windbags, who are manifestly incapable of "guiding their men to victory." These talkers would be nothing, and could do nothing, if it were not for the help they receive from the newspaper press, which tickles their vanity, and, in return, makes much "copy" out of them. If the modern run of strike organizers knew their own wretched business, there might be something to be said for them; but this cannot be conceded after the hideous blunder and crime of the Scotch miners' strike. There seems to be a pretty general opinion in Scotland, however, that the professional agitators have done for themselves this time in the Scotch coal-fields. The only bright spot in the whole miserable business consists in this reflection, which was expressed by our correspondent, that for some time to come the labour leader will be scarce in this part of the kingdom. We hope, however, that this will not be the only good result to come out of so much trouble; but that now, during the calm that must follow the great storm, the employers and the employed in the Scottish coal trade will take the opportunity of setting up for themselves something like the Welsh mutual arrangement for rendering the renewal of labour disputes improbable, if not impossible.

Mr. J. T. Wynn, of Melbourne, is now in England; having, we understand, resigned his position as Chief Engineer of the Melbourne Metropolitan Gas Company.

Imperial Continental Gas Association.—At the meeting of this Association on the 6th prox., the Directors will recommend a dividend of 5 per cent. for the six months ending June 30 last, together with a bonus of 1 per cent., both tax free.

WATER AND SANITARY AFFAIRS.

THE "Analysis of the Accounts of the Metropolitan "Water Companies," by Mr. Alfred Lass, F.C.A., relative to the past year, has just been published. This useful publication has now reached its fourteenth issue; the series serving to provide a complete history of the Metropolitan Water Supply for that period, so far as statistics can represent it. If we go back to the first issue—that for 1880—we find the average daily supply to be something over 142 million gallons, or about 31·8 gallons per head. Last year the daily average closely approached 192 million gallons, amounting to 35·46 gallons per head. The estimated population supplied has increased from 4,469,000 to 5,408,000. The supply has thus more than kept pace with an increase in the population not far short of a million. In 1880, the constant supply, though advancing rapidly, had only extended to 160,674 houses. Last year the number had become 596,240, out of a total of 801,582. But if we only compare 1893 with 1892, we obtain results sufficiently striking. The average daily supply, between one year and the other, shows an increase considerably exceeding 5 million gallons; and the proportion per head is augmented by 2¼ gallons. It is rather curious that the average number of persons supplied per house has dropped in the latter year compared with its immediate predecessor; the last return showing 6·75 instead of 7 per house. The capital employed per million gallons is subject to a diminution; being £224, as compared with £226. The difference is not very much, and, of course, is partly dependent on the enlarged supply. The actual capital employed has risen from £15,483,442 to £15,709,308, or about £226,000. The net profit on stock and share capital exhibits a slight increase—rising from 9·46 to 9·51 per cent.; but the net profit per volume of water is less than in the previous year. The growth of rates and taxes (exclusive of income-tax) is a sore subject with Railway Companies; and certainly the London Water Companies have good reason to cry out. In their case, these imposts have actually been considerably more than doubled in amount since Mr. Lass first published his "Analysis," whereas the net water-rates have increased by little more than one-third. In 1892, rates and taxes exceeded £186,000. Last year a further advance made them more than £198,000, or 10 per cent. on the gross income—constituting a truly tremendous tax. The New River Company paid not much less than £62,000, or a fraction below 12 per cent. on their gross income. The most fortunate of the Companies was the Kent, which paid 7·65 per cent. It always seems to us a question worthy of consideration, as to the effect on these rates and taxes if the County Council should ever take the place of the Water Companies. So far as we can see, when the Companies no longer furnish the money, the ratepayer must make up the deficiency, or at least miss the benefit of the payments which the Companies now have to provide. In one year the contribution has risen by £12,000; and Mr. Lass's next "Analysis" will doubtless show a total of at least £200,000—a sum not far short of 1½d. in the pound if levied on the entire rateable value of the Metropolis. Of course, the rates and taxes go into various treasuries, and not solely into the exchequer of the County Council. But if ever the Water Companies are extinguished, something in the nature of revenue will certainly be missed in the region of local finance. In the meantime, the Companies carry a burden which seems out of all due proportion to their proper liability. Respecting Mr. Lass's "Analysis," which has served as our text, we cannot refrain from calling attention, as in former years, to the comprehensive nature of the tables, embracing all that relates to the finances of the several undertakings, and placing these in comparison with the data of the supply. This is not a mere reproduction of the accounts issued by the various Companies, but strictly an "Analysis," carefully and elaborately worked out, so as to put all the facts in due relation to each other.

Death of Mr. J. B. Doe.—We have to record the sudden death, on the 10th inst., of Mr. Joseph Boulton Doe, J.P., one of the Directors of the Tottenham and Edmonton Gas Company. He was elected not long since in succession to Mr. J. Malcolm (the Deputy-Chairman), who resigned after 38 years' service.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 794.)

It was only to be expected that the Stock Exchange should be a sufferer during the past week from the serious apprehension that has agitated the minds of even the most panic-proof. We need do no more than allude to the dying condition of two Oriental rulers, who, singularly enough, howsoever antagonistic, are each a mainstay of the peace of the world. That the markets should droop was a foregone conclusion; and this tendency has affected all, for it would be difficult to find a single stock in the chief departments worth mentioning that has not receded. Of course, a few specialities among the mining and miscellaneous groups have been exempt—for special reasons. The Gas Market also has naturally been unaffected by political considerations, and has indeed developed fresh strength during the week. Business, too, in point of volume was well up to the mark. Of the Metropolitan undertakings, Gaslights were very active. The "A" was steadily done through the entire week at even figures—a fraction above or below 251, which was the closing mark. But the greatest activity towards the end of the week was shown in the secured issues of all descriptions—debenture, preference, and limited, which changed hands freely at high figures; the 4 per cent. debenture, at 130, being the highest. There was not much to sell in South Metropolitans; but what was offered readily commanded the top prices, though the "A" was the only issue whose quotation was advanced. A small quantity of Commercial old was disposed of at an advance; but the stock is very scarce. Perhaps the most noteworthy feature of the week was the general advance of the Suburban and Provincial division, almost all of which, without exception, are substantially dearer, as will be more particularly seen on reference to the list at p. 794. Bristol is the highest priced open stock in the market. The Continentals were pretty brisk and very firm, though Union was the only one actually to advance. There was hardly anything to notice among the rest, except that Oriental, for no apparent reason, was put a fraction lower. In Water, there was scarcely anything done, except in East London and Lambeth; but the tendency is all in favour of higher prices.

The daily operations were: The Gas Market was not very active at the opening; but prices in general were good. Bristol rose 2. In Water, East London and both Lambeths gained 2 each. Tuesday was very quiet; but prices were even better. Commercial old advanced 2; and British, ½. Wednesday was quiet and strong. Brentford old rose 5; ditto new, Brighton, and Crystal Palace, 2 each; and South Metropolitan "A," 1; but Buenos Ayres fell ¼. Thursday was more active; and prices were still on the rise. Continental Union rose 2. In Water, West Middlesex advanced 2; and Chelsea, 1. Friday was lively, especially for Gaslights of all sorts. Both Dublins improved by ½; but Oriental fell ¼. Excellent prices throughout ruled on Saturday; and Crystal Palace advanced 2 more.

ELECTRIC LIGHTING MEMORANDA.

The Economy (?) of the Worcester Combination—A Mild Electrician's Prophesy—A Breakdown in the Lighting of the City of London.

In last week's Journal, we gave a brief account of the electric lighting works of the Corporation of Worcester, which were recently inaugurated with considerable civic and scientific pomp. The installation has been designed by Mr. W. H. Preece; the electrical engineering portion of it carried out by the Brush Company; and the whole concern has been favoured by receiving what passes in science circles as equivalent to benediction at the hands of Sir Douglas Galton. We do not know what authority Sir Douglas Galton has to pose as a judge of the design and prospects of an electric lighting undertaking; but it was doubtless comfortable to the Worcester people to have his assurance that by the plan upon which their central station has been laid out, to utilize water power in conjunction with steam, they may hope to get electric lighting nearly as cheap as gas. There are two ways of regarding this matter, however; and we should prefer to have the opinion of a competent and impartial mechanical engineer upon the wisdom of the Worcester plan. Meanwhile, it is evident that the Mayor is not altogether easy in mind in respect to the "huge initial outlay of £50,000" in which Mr. Preece's plan has involved the city. His Worship is fain to declare that the venture is "bound in a brief period to be a great financial success;" but we hope the ratepayers will not be impatient for the arrival of this period. For, as a pure matter of engineering criticism, it is pretty evident that the Worcester combination is an example of the spending of sixpence in order possibly to save a penny. The Corporation have been put to enormous expense to "utilize"—blessed word!—a water power three miles out of the town, which is at best competent to do only a part of the required work; and it has therefore been necessary to lay down as much steam-power plant as though the water power were not in existence. And when it is remembered that the whole cost of producing a unit of electricity by steam power averages, for English central lighting stations, something near 2d., it is very difficult to realize how the combination of a small water-power section with the steam plant can be worth anything like its cost in Worcester or anywhere else. However, Mr. Preece has advised it; and Mr. Preece is, of course, a great electrician. What is more, the Corporation of Worcester have paid for it; and it is to be hoped they will never repent of their bargain.

The proneness of partisans of electric lighting to prophesy is innate and incorrigible. It is satisfactory to notice, however, that these electrical prophets now couch their predictions respecting the future of electric and gas lighting in much milder terms than would have served them a few years ago. An illustration of this may be found in the comment of an electrical contemporary upon a statement in Mr. George Livesey's New Cross address: He said that in South London the consumption of gas has doubled during the past fifteen years, notwithstanding the competition of petroleum and the electric light; whereupon our contemporary ventures to "predict that at the end of the next fifteen years this statement will not apply." The period fixed for proving the correctness or falsity of this forecast is sufficiently remote to deprive it of all but a very faint interest in the present; but when one recalls what electricians *circa* 1879-80 said about the prospects of gas lighting for the period which has since elapsed, it becomes evident that their prophetic ardour has become greatly chastened. It is no great matter whether the quantity of gas consumed fifteen years hence in South London is or is not exactly double the amount for the current year. If this should turn out to be the case, then a number of people with capital to invest will have found a safe and profitable employment for their money at market rates; but if the expansion of the gas industry should be slower in the future than it has been of late years, nobody will suffer thereby. Once upon a time, nothing would satisfy electricians rejoicing in the gift of prophecy but seeing gas-holders everywhere sent to the scrap heap and retort-houses converted into electricity supply stations—which is an altogether different thing.

Since the *Electrician* makes prominent mention of the incident, there can no offence in our referring to the "unlucky breakdown of some of the switching machinery at the Bankside station," whereby, on the 9th inst., "the whole of the supply, with the exception of that for the street arc lamps, had to be stopped for several minutes" in the middle of the afternoon and in the City of London. Naturally, "the circumstance was rendered all the more unfortunate by the fact that the City was plunged in a fog at the time, and every available artificial light was in use." This is precisely the opportunity which malignant Fate would be likely to take for demonstrating the unreliability of an electric lighting company's service arrangements. Of course, an elaborate explanation of the causes of the breakdown is offered; and it is claimed that the trouble was quickly localized and remedied. It will be noticed that our contemporary's version of the incident states vaguely that the lights were out for a period described as of "several minutes'" duration. Other information has it that the interruption lasted half an hour or thereabouts; but, in any case, it was a bad thing for the reputation of the electric light in the City of London. The *Electrician* admits that "mischief must inevitably result from this mishap to other supply companies who have never had a hitch of any sort, and with whom even a flicker is extremely rare, and even to the whole industry, by shaking the confidence of the public in electric lighting." Surely, this is a very pessimistic view to take of a by no means unprecedented or generally remarkable breakdown. It is extremely unfortunate for the Company concerned that the failure should have occurred, especially as it cannot be explained away by blaming a stoker, or a lamplighter, or the cat, or any other delinquents such as have been set up before now to take the blame that would otherwise have fallen upon the sacred "system" when things have gone wrong with the light. But to talk of this particular mishap as shaking the confidence of the public in electric lighting is to fear for the security of something that never existed. People who take up with electric lighting know the risks they run; and they have only themselves to accuse if a breakdown at an especially awkward moment finds them unprepared with a temporary substitute.

A Tunnel for Gas-Pipes under the River Lea.—For some months past The Gaslight and Coke Company have been constructing a 6-feet diameter cast-iron tunnel under the River Lea, at Canning Town, and on Saturday, the 13th inst., the principal officers of the outdoor staff, to the number of 36—consisting of the Divisional Chief Inspectors, Senior Inspectors, and other gentlemen connected with the department—inspected the work, by special invitation of the Distributing Engineer, Mr. G. F. L. Foulger. The members of the party were personally conducted in detachments through the "tunnel main" by Mr. Foulger, who fully explained the details of construction, of which we shall be giving some particulars in a future issue. Very great interest was shown in the plan and general design of the tunnel; and the officers had nothing but praise to offer for the skill and ability with which the work had been conceived and carried out, and every possible contingency provided for. The party were subsequently entertained at dinner by Mr. Foulger at his house on Clapham Common, where his health was drunk with much enthusiasm.

WATER ACTS FOR 1894.

HAVING, in the two preceding issues of the JOURNAL, disposed of the gas legislation of the past session, we have now to deal with the Acts relating to water supply.

The Central Middlesex Water Act authorizes the Central Middlesex Water Company, Limited, to sell and transfer a portion of their undertaking to the Colne Valley Water Company. The latter Company were incorporated by an Act of 1873, which contained a clause forbidding them to supply water within the parts of the parish of Harrow-on-the-Hill therein mentioned without the written consent of the Harrow Water-Works Company. The Alperton and Sudbury Water Order, 1884, authorized the undertakers to supply water in certain parts of Middlesex, which authority has been assigned to the Central Middlesex Water Company, and covers the district dealt with by the Act. Moreover, the undertaking of the Harrow Water-Works Company was transferred to, and vested in, the Colne Company by an Act of 1885. Doubts having arisen as to whether the Alperton and Sudbury Order gave power to the undertakers to assign their authority, these doubts are removed by an enabling clause in the present Act. The agreement between the Central Middlesex Company and the Colne Valley Company for the transfer of the portion of the undertaking in question, which relates to parts of the parishes of Harrow-on-the-Hill and Northolt, specifies that the consideration for the transfer is a payment of £10,250. No guarantee is given in respect of the state of the water-mains, &c. The agreement, which contains numerous special conditions, forms a schedule to the Act, and is confirmed by it. Restriction is laid upon the supply of water obtained from the valley of the Colne, or from any source within the county of Hertford, to districts outside the county, with the exception of the transferred area and within the statutory limits of the Colne Valley Company. The Consett Water-Works Act enables the Consett Water-Works Company to raise £225,000 of further share capital, to bear 7 per cent. dividend, to carry the usual borrowing powers. Additional works are authorized, comprising several reservoirs for impounding the waters of the Eudon Burn, Pike Sike, Feldon Burn, and Hisehope Burn, mainly situate in the parishes of Edmondbyers and Muggleswick, subject to obligations in respect of compensation water. Some of the works are to be completed within ten, and the remainder within fifteen years. The limits of supply are extended to include several parishes and townships in the counties of Northumberland and Durham. A portion of the district of the Company in the parishes of Lanchester and Chester-le-Street is transferred to the Weardale and Shildon Company. The Company may supply water in bulk to local authorities, subject to the obligation to procure the written consent of the Newcastle and Gateshead Water Company in respect of districts within the statutory limits of the latter Company. No water is to be furnished for manufacturing or mechanical purposes to the prejudice of the domestic supply; and all water for domestic use is to be efficiently filtered after Dec. 31, 1896.

The East London Water-Works Act authorizes the Company to create and issue £500,000 of debenture stock, subject to the direction that the rate of interest attached thereto shall be such as, in the opinion for the time being of the Governor of the Bank of England, is best calculated to secure the issue at par. All debenture stock created is to be redeemable by the Company at par at any time after the expiration of 25 years from the date of issue. From and after the expiration of three years from the date of issue of this debenture stock, there is to be carried to a sinking-fund in each year such a percentage on the amount, and any premiums received upon it, as shall be equal to the excess of the average percentage of dividend and interest paid for that year on all the Company's capital above the rate of interest at which the new debenture stock was issued, with an additional 1 per cent. for management. This sinking fund is to be held and applied by the Chamberlain of the City of London as trustee for the purpose of purchasing and holding stock of the Company, and of investing the dividends thereon with a view to ultimately extinguishing the capital, or for such other purposes as Parliament may from time to time determine. Certain additional water-works are to be constructed, including two storeage reservoirs and an extension of a third, together with subsidiary works, to be completed within seven years. The moneys to be raised under the Act are strictly allocated to different puposes. Provision is made for the use by the Company of Lammas or commonable lands at Low Leyton.

The Newcastle and Gateshead Water-Works Act authorizes the abandonment by the Company of the construction of the Catcleugh reservoir on the River Rede, sanctioned by their Act of 1889, and the construction in lieu thereof, and partly on the same site, of a larger reservoir, required for improving the supply of a portion of the borough of Gateshead. Two Arbitrators are named in the Act, with power to choose an Umpire, for the supervision of the compensation arrangements: Immediately after the passing of the Act, the Arbitrators are to erect and maintain during the next seven years, at the cost of the Company, such rain-gauges fixed upon the drainage area of the Catcleugh reservoir as they may think necessary for the purpose of ascertaining the total amount of the available rainfall; and when this has been so determined, the Company must discharge in a continous stream into the River Rede a uniform daily quantity of water equivalent in every year to one-fourth of the said available rainfall. Meanwhile, the discharge during the construction of the reservoir is to be 4½ million gallons daily during the months of February, March, and April, and 2 million gallons daily during the remainder of the year. The penalty of £200 a day may be imposed for any infraction of these provisions. Saving clauses for the protection of numerous public and private interests are inserted in the Act; and it sanctions the raising of £500,000 of new 5 per cent. share capital, to carry the usual borrowing powers. Power is given to the Company's inspectors to enter the courtledges of premises supplied with water, and seek for wastages. The Southend Water-Works Act authorizes the raising of £80,000 of additional 7 per cent. share capital of the Company, carrying the usual borrowing powers. The limits of supply are extended to include the parish of Thundersley, in Essex. Additional works, comprising four pumping-stations and the necessary subsidiary works, are sanctioned, to be completed within the next 15 years. The South Hants Water Act extends the limits of supply of the South Hants Water-Works Company to include the town of Lyndhurst and a number of other parishes, subject to agreement with the West Hampshire and the Bishop's Waltham Water-Works Companies. The issue of £80,000 of new 7 per cent. capital is authorized by the Act, with the usual borrowing powers. The terms upon which the Company are to be allowed to deal with certain portions of the New Forest land are defined. The Company, with the authority of three-fourths of the votes of their shareholders in general meeting, may contribute towards the funds of an employees' benefit society; and also erect houses and cottages for offices and servants. The Company may remove consumers' fittings from unoccupied premises. With the approval of three-fourths of the proprietors in general meeting, the Company may enter into agreements with owners of private water-works in the district to purchase or lease those works.

The Southwark and Vauxhall Water Act is to empower the Company to raise £750,000 of additional capital by the creation and issue of "B" debenture stock at par, under the same general conditions that apply to the similar new issue of East London debenture stock already mentioned. Twenty-eight days' notice of the sale of such stock must be given, and the sale advertised at least four times during this period in two or more London daily newspapers. The money to be raised is strictly allocated to different purposes. At any time within twelve months after the passing of the Act, the Company may, with the consent of three-fourths in value of the holders of each separate class of their old debenture stocks, consolidate such stocks under the name of debenture stock "A" of one class, and bearing a uniform rate of interest not exceeding 4 per cent. per annum. The Company's limits of supply are extended to include a small portion of land in the parish of Lewisham. New water-works are to be constructed, including a service reservoir on the boundaries of the parishes of Camberwell and Lewisham; and also a storeage reservoir, which will be partly in the parish of Hampton and partly in the parish of Sunbury, having a superficial area of 1,553,800 square feet or thereabouts, with a subsiding reservoir to be built in the parish of Hampton, having a superficial area of 1,399,520 square feet or thereabouts. The works are to be completed within seven years, with the proviso that the storeage and subsiding reservoirs are to be commenced as early as may be practicable after the passing of the Act, and be carried out with all due diligence. So soon as the Company shall be able to abandon the use of their works at Battersea, and shall sell the land, the proceeds of such sale shall be treated as capital; provided that, in the case of any sale of land completed before the issue of "B" debenture stock, the net proceeds are to be considered as a portion of such stock. In the event of the net proceeds of such sale exceeding the amount of the "B" debenture stock, the excess is to go to the cancellation of an equivalent amount of "A" debenture stock. If the whole of the "B" stock is issued before the completion of any land sale, the proceeds are to be applied to the cancellation of either class of debenture stock or of the share capital of the Company, or otherwise as Parliament may direct. The West Middlesex Water-Works Act authorizes the Company to raise £440,000 of redeemable debenture stock, subject to the same general conditions as the similar issues of the other Metropolitan Water Companies already mentioned. Before creating any new debenture stock, the Company must apply to the purposes of the works authorized by the Act the sum of £52,500, being part of the sum of £107,725 shown by the last half-yearly accounts of the Company to have been accumulated out of profits after paying the maximum authorized dividends, and must also apply to the like purposes the sum of £7500 standing to the credit of the repairs and renewal fund. The balance of the accumulated sum is to augment the reserve fund. The allocation of capital to different purposes is defined; and it is provided that the subsidence and storeage reservoirs and filter-beds are to be commenced as soon as practicable after the passing of the Act, and be prosecuted with all due diligence. No description of such works appears in the Act, besides the directions that a sum of £140,000 is allowed for the construction of reservoirs; £45,000 for the purchase of the Shoot-up Hill reservoir; £60,000 for filter-beds; £75,000 for engines and engine-houses; £100,000 for suction and pumping mains; and £50,000 for ordinary extensions of mains and services.

The Aberdare Local Board Water Act authorizes the Local Board to construct additional water-works, comprising a reservoir upon the stream known as Nant Melyn and certain pipe-lines, subject to the right of the Aberdare and Glamorganshire Canal Companies to compensation water at the rate of 31,380 gallons a day from the Nant Melyn stream, and 27,070 gallons a day from the Nant Moel Uchaf stream. The Local Board are empowered to raise £28,000 for the purposes of the Act, to be repaid in 50 years. The Abertillery Local Board (Gas and Water) Act authorizes the transfer of part of the undertaking of the Brynmawr and Abertillery Gas and Water Company to the Abertillery Local Board, in accordance with the terms of a scheduled agreement. The Local Board are empowered to borrow £5000 for the purchase of the water-works portion; £17,000 for renewing and extending water mains and pipes; and £30,000 for the construction of new water-works, to be repaid in 45 years. The new works comprise an impounding reservoir on the Tillery Brook, delivering compensation water after the rate of 300,000 gallons a day. The Accrington District Gas and Water Board Act constitutes and incorporates a Gas and Water Board for the Borough of Accrington and the districts of the Local Boards of Church, Clayton-le-Moors, Great Harwood, and Rishton, in the county palatine of Lancaster. An agreement for the transfer to the Board of the undertaking of the Accrington Gas and Water Company is confirmed, by which the Board engage to pay the Company £5000, and grant annuities to the proprietors. The sum of £56,000 is to be raised for water-works purposes. The Board are to make provision for the redemption of the debenture stock of the Company, and of any annuities issued by them under this Act, by means of a sinking fund, so as to extinguish the whole of such stock and annuities within 60 years from the passing of the Act, at the rate of 35 years' purchase of the "A," and of 30 years' purchase of the "B" redeemable annuities, and of the interest on the debenture stock. The surplus of the water revenue is to be applied in reduction of the charge for water supplied for domestic purposes. Any deficiency of either the gas or the water revenue may be temporarily made good out of the other.

Sir F. Nicolson, the Chairman of the Thames Conservancy Board, has just been presented by the members of the Board, the staff, and the employees, with a service of silver plate, in recognition of the benefits conferred by him on the public during the twenty years he filled the position of Deputy-Chairman.

Wide Tendering for Pumping Machinery.—In the JOURNAL for the 9th inst., we announced the acceptance of a tender by Messrs. J. Watt and Co., amounting to £8980, for the construction, erection, and maintenance of a pumping-engine and other machinery required at the Patcham pumping-station of the Brighton Corporation Water-Works. It may be of interest to add that eleven tenders were submitted for the work; and they presented the extraordinary difference of £10,000 between the highest and the lowest. Of course, without knowing the conditions of the tender, we cannot do more than regard with curiosity the fact that while one firm required £16,986 for the work, another offered to do it for £6770. The latter firm and the successful tenderers were the only two whose totals did not reach five figures.

The Baku Petroleum Industry.—According to an article in the *Chemiker Zeitung*, the production of Baku petroleum is becoming concentrated in the three districts of Balachani-Sabuntschi, Bibi-Eibat, and the Romany Plain. The output of oil last year was 337,051,834 poods, of which 324,763,197 poods (about 5,235,000 tons), or an increase of 13·6 per cent. over the previous twelve months, was further worked in refineries; the remainder being employed as fuel, or wasted. The increase is said to be mainly due to the greater yield from fountains, where no pumping is needed, about one-third of the total production being from this source. These fountains have lowered the price of the crude petroleum, which varied between 2·75 kopeks (about ¾d.) per pood, or 36 lbs., in winter, and 0·75 kopek in summer. In 1893 there were about 38 fountains, and 458 wells where pumping was necessary; the average yield per well being about 470,000 poods (7577 tons) per annum. In 1893, there were 249·5 versts (about 165 miles) of pipe-lines, varying from 3 to 6 inches in diameter, connecting the wells and factories, &c., and estimated to be capable of manufacturing about 1,440,000 poods (23,000 tons) of oil daily. There were only 85 refineries, of which many were not working to their full capacity. This change is due to the growth of the large establishments at the cost of the small ones. The products of these refineries are as follows: Refined petroleum, 85,633,971 poods (1,380,000 tons); oil, 6,232,740 poods (100,000 tons); benzene, 252,493 poods (4000 tons); tar, asphalte, gasolin, &c., 437,620 poods (7000 tons); and petroleum residuals, 143,538,899 poods (2,310,000 tons). These numbers represent the quantities now exported, and are therefore exclusive of the stuff used on the spot. Formerly the distillation was carried as far as possible—an average of 36·5 per cent. of the crude petroleum having been obtained as distillate. Now that the value of the residuals has risen, and is generally higher than that of the oil, only about 29·5 per cent. of the crude oil is distilled over. In addition to this oil, even asphalte, gasolin, &c., are sometimes added to the residuals.

NOTES.

Qualitative Tests for Gases.

In the course of an exhaustive research into the nature, origin, and analysis of natural gas, Mr. F. C. Phillips was impressed with the comparatively small amount of attention that has been generally paid to the qualitative analysis of gases in general. He has accordingly collected statements of the more important reactions of the commonest gases; and these have been published in the *American Chemical Journal*. The reactions are classified into (1) oxidation phenomena of hydrogen, carbon monoxide, and hydrocarbons in the presence of certain finely-divided metals, and other oxidizing agents; (2) reactions between gases and various compounds in solution and when dry at high temperatures. From the experimental investigation of the oxidation phenomena, it was concluded generally that the temperature of oxidation for mixtures of gaseous hydrocarbons with air is mainly dependent upon the solid bodies with which the air is in contact. This oxidation process generally shows two phases, the first in which the operation is very slow until the temperature has sufficiently risen, when it suddenly becomes intense. Oxidation does not always take place at the same temperature, even when the mixture and the environment remain constant. The oxidation temperature is not materially influenced by variations in the proportion of hydrocarbon to air in the mixture. The lower members of a given homologous series of hydrogen resist oxidation better than the upper. As regards the qualitative reactions of gases, it is admitted that the recognition of any gas in a complex mixture is often most difficult. There are but few groups like those of Fresenius in metals; and the members of these greatly resemble one another. Mr. Phillips proposes seven groups of gases. The first contains only hydrogen; the second, carbon monoxide; the third, methane, ethane, propane, &c.; the fourth, ethylene, propylene, &c.; the fifth, acetylene, allylene, &c.; the sixth, the sulphur compounds; the seventh, carbon dioxide. Nitrogen and oxygen are unclassed. The reactions proposed by the author are very numerous.

A New Luminescence Lamp.

A claim to the production of an extremely economic artificial light by utilizing electric oscillations of the Tesla type, is made by Herr Ebert, whose device is explained in Wiedemann's *Annalen*. The author describes what he calls a "luminescence lamp," made of a glass globe containing a piece of luminous paint. Electric oscillations are conducted to tinfoil armatures on the globe, and produce vivid luminescence. The illuminating effect in the case described was about 1-30 to 1-40th of an amyl-acetate standard unit of light. The energy consumed could only be counted in millionths of a watt; so that the economy of the new lamp is very striking, consuming as it does only about 1-2000th part of the energy required to maintain an amyl-acetate lamp. The familiar difficulty involved in the fact that the high-frequency currents employed in such experiments cannot be conducted to any great distance without encountering enormous inductive resistances, might, it is suggested, be overcome by effecting the transformation in the immediate vicinity of the lamp. Since only condensers of small capacity and inductance are required, the lamp itself might carry its own transformer.

Lodge on Lightning Conductors.

Writing in the *Engineering Magazine* on the subject of lightning and lightning conductors, Dr. Oliver J. Lodge remarks that the theory of lightning rods consisted in the idea, which originated with Franklin, of a charged cloud as a reservoir of electricity which desires to come down to earth, and the consequent belief that all that is necessary, in order to enable this to be done, is to provide the electricity with an easy path—to wit, a rod of good conducting material. Whenever this arrangement failed to act in the way expected of it—wherever a side flash sprang from it to other and apparently inferior conductors, wherever gas was ignited by apparently quite detached and unstruck conductors, it was customary to abuse the lightning-rod as badly erected or imperfectly tested. The "earth" came in usually for the larger share of blame; but it is now known that in no case can a defective earth be held accountable for the whole of the mischief. The truth, as it is now understood, is that lightning is an oscillatory discharge of enormous energy, which no copper rod, however thick and long, can really dispose of harmlessly. Experimentally, it can be shown that when a lightning discharge takes place, even down such a rod as this, sparks may fly from it to all conductors near, capable of setting fire to any explosive compound or gas leak which they may chance to encounter. Practically, Dr. Lodge recommends for the protection of ordinary buildings the placing of a wire along all the gables, and down all the corners, with perhaps a few in between along any prominent features, so as to enclose the building in a sort of wide network. Any metal serves equally well for the conductor; conductivity being unimportant in comparison with durability. Points or projections to the sky are useful to take the violence of the direct flash at its point of incidence in a cheap and conspicuous manner. Earth connections are desirable to save the foundation, the soil, and the pipes therein from being damaged. After receiving a flash,

all cellars and places likely to contain gas-pipes should be inspected. Nor should a custodian of an important building rest secure until a sufficient lapse of time has rendered it unlikely that any minute ignition may be gaining headway in some obscure or inaccessible region. Plenty of iron wire instead of a single copper rod seems to summarize Dr. Lodge's prescription for the protection of ordinary buildings. For lofty chimneys, however, he suggests in addition throwing the conductor across the opening of the shaft.

Midland Association of Gas Managers.—The autumn general meeting of this Association is fixed for Thursday next. We learn, from the *agenda* issued by the Honorary Secretary (Mr. C. Meiklejohn, of Rugby), that the business will consist of the election of new members and of officers for the ensuing year, and the reading of two papers—one by Mr. William Belton, Assoc.M.Inst.C.E., of Shrewsbury, entitled "A Sketch of a Process Affecting Gas Purification and Sulphate Producing;" the other by **Mr. J. T. Lewis,** of Wellingborough, on "The Use of Charging and Drawing Machinery in Small and Medium-Sized Gas-Works."

The Disinfection of Town Sewage with Sulphuric Acid.—In a recent volume of the Proceedings of the Institution of Civil Engineers, there is an account of some experiments carried out by Dr. M. Ivanoff, with the view of ascertaining the action of dilute sulphuric acid upon the bacteria of cholera in sewage water. The samples treated were derived both from the Berlin and the Potsdam sewers; and they were infected alternately with pure cultures of the cholera bacillus and with the fresh dejections of a cholera patient. The acid in the case of the Berlin sewage water was used in three degrees of strength—viz., (1) as a 0·02 per cent. solution; (2) as a 0·04 per cent. solution; and (3) as a 0·1 per cent. solution. The conditions under which the analyses were made are fully described; and the author availed himself of microscopic observations, as well as bacteriological tests. Four parallel series of experiments were carried out; and the results were in every case identical. The Potsdam sewage, which is three times as concentrated as that of Berlin, was treated with stronger acid—viz., with 0·04, 0·06, 0·08, and 0·12 per cent. solutions. It was found that, in the case of the Berlin sewage, the 0·04 per cent. solution of acid was fatal to the cholera bacilli; but that with the stronger sewage water of Potsdam, the amount of acid needed was that present in the 0·08 per cent. solution. It is pointed out that, whereas previous to treatment the sewage water was faintly alkaline, the sample to which 0·08 per cent. of acid had been added had a strong acid reaction on being tested with litmus paper, and that such reaction may be regarded as an indication that the necessary dose of acid has been employed. With the exception of the use of lime, this treatment is stated to be the cheapest that can be adopted.

The Superannuation of Corporation Servants.—In last Friday's issue of the *Birmingham Post*, there appeared an article on this subject, the writing of which had evidently been suggested by the strong feeling which has been expressed by many ratepayers, at recent ward meetings, as to the payment of superannuation allowances to servants of the Corporation who have been in receipt of liberal salaries. Some of the candidates for municipal honours, or their leading supporters, it appears, are inclined—not altogether honestly, remarks our contemporary—to make capital out of the vote of a retiring allowance to Mr. J. W. Gray, who for a great number of years has filled the post of Engineer to the Water Department. The *Post* favours the principle of superannuating public servants who, through long service, have ceased to be equal to the demands of their office, and concludes its article by saying: "The Gas Department has superannuation funds for its salaried officers and for meter inspectors. The former was established in 1876; and the latter in 1882. Upon the establishment of these funds, it was provided that every member of the staff thereafter joining the service of the Gas Department should, if under forty years of age, become a contributor to the superannuation fund. Men already in the service had the option of joining the fund, with the further provision that, if a man was over forty years of age at that date, he might be allowed to pay back-contributions to the date of his fortieth birthday, with interest thereon, and also interest on the contributions which the Corporation would have paid into the fund. The basis of the fund was a contribution by the employees amounting to 2½ per cent. upon their salaries; and a corresponding payment by the Gas Department. At sixty years of age, and having contributed for twenty years, members of the fund might retire, broadly speaking, on a pension of one-third of their salaries; but if they had contributed for forty years, the allowance was to rise to two-thirds of the salary—there being a sliding-scale for periods of contribution between the two at the rate of one-sixtieth of the salary for every year's service above twenty years. In 1871 the two funds were amalgamated; and some modifications were made in the scale of retiring allowances, which were considered to be more equitable as regards the officials of long service, although some of the subscribers do not regard the changes favourably. Practically the whole of the staff are under the fund; and its existence at least demonstrates that the difficulties in the way of establishing a similar fund for other departments are not insuperable."

TECHNICAL RECORD.

THE PHOTOMETRY OF DIFFUSED REFLECTION.

In a paper published in Wiedemann's *Annalen*, Herr E. Lommel treats of the photometry of diffused reflection. The same writer has shown in a previous paper that in theoretical photometry it is not the surface elements of the luminous surface, but the volume elements of the luminous body, which should be regarded as emitting light. Accordingly, the following three propositions were taken as a basis for the theoretical treatment of photometric problems: (1) The quantity of light radiated from one volume element to another is inversely proportional to the square of their distance. (2) The quantity of light emitted from a volume element, and incident upon a surface element, is proportional to the cosine of the angle of incidence. (3) The light radiated by a volume element is enfeebled on its way through the radiating body according to the law of absorption. Thus Lambert's law of the cosine of the angle of emission was eliminated from the set of photometric principles, and the present third proposition put in its place. The cosine law was now obtained as a consequence of the above principles, but only for opaque incandescent bodies. It does not hold good for self-luminous bodies transmitting light, such as flames. In this paper ("On Fluorescence") the author took only the behaviour of self-luminous bodies, incandescent and fluorescent, into account; leaving untouched the much more difficult problem of bodies radiating borrowed light by diffused reflection. For such bodies also it has been customary, since Lambert, to take the cosine law as determining the intensity of the light reflected by them. This assumption, however, could neither be based on theory, nor did it appear to correspond with the facts of observation. This consideration has recently been emphasized by Seeliger, with special reference to the photometry of planets. He showed by a series of observations that an experimental corroboration of Lambert's law could not be derived from light-diffusing bodies. Having gone into this subject, Lommel finds: (1) If through the surface $d \propto$ of the volume element $d \propto d \rho = d v$ of an illuminated diffusing body, the amount of light $d \propto$ (*i.e.*, unit light per unit of area) penetrates perpendicularly, let $l\, d \propto d \rho$ be the amount of light diffused in all directions by the volume element. The quantity l we may call the *diffusive power* of the body. This is independent of the colour of the incident light, and only depends upon the degree of dulness, pulverization, disintegration, sponginess, cracked structure, &c., of the body; for a perfectly clear, limpid body, the diffusive power l is zero. (2) Since the beam of light of intensity $d \propto$, in passing through the distance $d \rho$, loses the amount of light $l\, d \propto d \rho$ diffused in all directions, it is enfeebled by diffusion according to the same law as determines absorption. (3) At the same, it is also enfeebled by absorption proper, both in passing through the diffusing particles themselves, and through the transparent medium in the space between them. By this absorption it loses the further quantity $k\, d \propto d \rho$, where the absorptive power k is a function of the wave-length, since both particles and medium may be coloured. (4) The supposition hitherto made that the volume element in lighting is a rectangular prism with its edges parallel to the direction of the incident beam, is unessential. For whatever may be the shape of the volume element, it may be supposed to be subdivided in a direction parallel to the rays into narrow right prisms, each of which affects the incident light in the manner specified. With a volume element of any shape, therefore, the quantities of light $k\, d\, v$ and $l\, d\, v$ are abstracted, by absorption and diffusion respectively, from a beam having the unit quantity of light per unit of sectional area. (5) The quantity of light $l\, d\, v$ is radiated in all directions by the volume element. If we assume that the radiation takes place equally every way, then the surface $4\, \pi$ of a sphere described with unit radius about the volume element is uniformly illuminated by the quantity of light $l\, d\, v$. The quantity of light, therefore, which the element $d\, v$ radiates in any direction per unit of area of this sphere is $\frac{l}{4\pi} d\, v$. For absolutely white bodies, the amount of light radiated by a surface element $d \propto$ in all directions, when illuminated by parallel rays at an angle of incidence i, is $a\, d \propto \cos i$; where a is the intensity of the incident light. The amount of light radiated by a body, equally illuminated from all points, in a direction at an angle ϵ to the normal, is $a\, d \propto \cos \epsilon$. Hence follow certain propositions: (*a*) If an absolutely white body is illuminated by parallel rays from any point, the amount of light sent out in all directions from its surface (its own illuminating power) is proportional to the cosine of the angle of incidence. (*b*) If the surface of an absolutely white body is equally illuminated from all directions, the quantity of light radiated by it in any given direction is proportional to the cosine of the angle of emergence. These propositions, enunciated for white bodies, also hold good in the cases of coloured bodies, when the colours are such as to possess indefinitely feeble absorption. Of the substances investigated, marble alone approximately follows the cosine law. According to the theory, it would only hold good in the case of illumination from all directions of a body approaching absolute

white. The values found for porcelain agree pretty closely with those calculated by the new law, while they diverge considerably from the cosine law. The intensity of light L radiated in a direction ϵ by an opaque diffusing body, when the light is incident vertically, is given in the formula—

$$\frac{4\pi}{a\,d\,\infty} L = \frac{l}{2\,(k+l)} (P + \mu Q),$$

where $P = \frac{2\cos\epsilon}{\cos\epsilon + 1}$, $Q = P(\log 2 + \cos\epsilon \log \frac{1+\cos\epsilon}{\cos\epsilon}$, and $\mu =$ a constant depending upon the physical constitution of the body.

A CONTRIBUTION TOWARDS THE STATICAL CALCULATION OF THE GUIDE-FRAMING OF INDEPENDENT* GASHOLDERS.

[We have received from Herr M. Niemann, of Dessau, a copy of his paper on the above subject, recently published in the *Journal of the Association of German Engineers*. We give below a full translation of the paper, and of a portion of the correspondence it induced. It should be explained that the translation has been revised throughout by Mr. F. S. Cripps, Assoc.M.Inst. C.E., who, in addition, has annotated the text and written some notes upon the paper, in which he has put the practical results into much simpler forms than those employed by Herr Niemann, and at the same time has introduced the value of the wind pressure, which was left as an uncertain factor. He has, moreover, facilitated calculations by eliminating all trigonometry, and employing simple arithmetic throughout his notes, which will be published in the JOURNAL next week.—ED. J. G. L.]

1.—INTRODUCTION.

In view of the many magnificent gasholders erected during the past decade, having, in England especially, an immense size, it is surprising that the methods for the statical calculation of the guide-framing of holders have been little improved. In the following paper, an attempt is made to arrive at a simple method of calculation which shall give results in accordance with practical requirements.

2.—PREMISSES.

The guide-framing for calculation shown in fig. 1† consists, in ground plan, of a polygonal lattice. The perpendicular standards AB, A_1B_1, A_2B_2 . . . have their lower extremities secured to firm masonry; and their upper extremities are joined to one another by horizontal bars or girders BB_1, B_1B_2, B_2B_3 . . . There are also the diagonals AB_1, A_1B_2, A_2B_3, and A_1B, A_2B_1, A_3B_2 . . . which only take tensional and not compressional strain. All joints at the points A, A_1, A_2 . . . B, B_1, B_2 . . . are conceived to be perfectly flexible. The gasholder bell has radial guides; that is to say, the guide-rollers can take up compressional strain only in the direction of the radii of the horizontal section of the holder. It is assumed that the lower guide-rollers exert their pressure on the masonry at the points A, A_1 . . . Consequently, the pressure of the upper rollers alone has to be considered. This acts at the points B, B_1, B_2 . . . The greatest strain must be caused by a wind pressure acting horizontally on the bell. The influences of a one-sided load of snow, and of the wind on the domed roof of the bell, as well as of the play and condition of unstable equilibrium of the bell, must remain unconsidered, as their introduction would produce great complications in the calculations; and sufficient account can be taken of them by assuming a somewhat greater wind pressure.

The horizontal bars BB_1 . . . and the vertical standards AB . . . must be regarded as constructed of such a strength that changes of form due to their elasticity can be neglected. The rollers also of the bell must be considered as uniting together to form a rigid polygon.‡ On the other hand, the diagonals are subjected to a linear expansion lying within the limit of elasticity, and proportional to the tensional strain of the diagonals concerned in each particular case. With a tensional strain of 1000 kilogrammes per square centimetre (14,200 lbs. per square inch), this expansion amounts for wrought iron to about 1-20th per cent.; and, consequently, for a diagonal 10 metres long, to about 5 mm. All the diagonals must be equal to one another in cross section and length. The resultants of the wind pressure must, for the sake of simplicity, be taken to fall exactly in the radius MA of fig. 2.

3.—METHOD OF CALCULATION.

From the foregoing assumptions, it follows that, under the influence of wind pressure, the whole of the upper corners of the polygon B, B_1, B_2 . . . are pushed by a certain degree in the direction of the wind; while the lower corners of the polygon A, A_1, A_2, . . . remain unaffected in their old position. The points B, B_1, B_2 . . . may pass to C, C_1, C_2, . . . In the ground plan (fig. 2), AC, A_1C_1, A_2C_2 are, therefore, the changes of position which the points B, B_1, B_2 . . . have undergone. We have agreed that the guide-rollers are joined to one another by the curbs to form a rigid polygon, so the middle point M of the polygon moves from its former position to M_1, and we have MM_1, AC, A_1C_1, A_2C_2, equal in magnitude and direction.

The diagonals have passed from their positions of repose, A_1B, A_2B_1 . . . to the positions A_1C, A_2C_1. . . . and have thus suffered extension. The amount of this extension has to be ascertained. If vertical planes are placed so as to contain the diagonals after they have shifted from their position of repose, their traces will appear in the horizontal section (fig. 2) as the lines A_1C, A_2C_1, A_3C_2 . . . which are likewise the horizontal projections of the stretched diagonals. In order to compare these horizontal projections with those of the position of repose—that is, with the lengths A_1A, A_2A_1, A_3A_2—drop a perpendicular from the points A, A_1, A_2, . . . to A_1C, A_2C_1, A_3C_2. Let the feet of the perpendiculars be D, D_1, D_2. When the displacement is but slight, A_1A may be taken as equal to A_1D, and AD regarded as perpendicular to A_1A. The lengths DC, D_1C_1, D_2C_2 . . . thus represent the horizontal projections of the elongations which the diagonals have undergone. Since these horizontal projections are proportional to the actual elongations of the diagonals, and since these elongations are so slight that the elastic limit is not overstepped, the lengths DC, D_1C_1, D_2C_2 are proportional to the forces which caused the extension of the diagonals. It is therefore possible, by calculating the lengths CD, C_1D_1, C_2D_2 . . . to establish the ratios which the tensions taken up by single diagonals bear to one another. A second relation for the estimation of these tensions is presented in the fact that the sum of their components in the direction of the wind must be equal to the wind pressure. As soon as it is established how many diagonals generally are stretched at the same time, and are to be considered in the calculation, there are all the data for determining every, and therefore the greatest, tension on the diagonals. The forces on the horizontal girders BB_1, B_1B_2, . . . those on the uprights AB, A_1B_1, A_2B_2, . . . as well as those forces acting radially which are taken up by the guide-rollers, are determined with ease by the resolution of forces, as soon as the strains of the separate diagonals are known.

4.—WORKING OUT OF FORMULÆ.

In figs. 2 and 4—

A, A_1, A_2 . . . are the corners of the regular polygon which the horizontal projection of the guide-framing forms when at rest.

M is the centre of the polygon A, A_1, A_2, . . .

C, C_1, C_2 are the corners of the regular polygon, which the horizontal projection of the upper end of the guide-framing forms on displacement.

M_1 is the centre of the polygon C, C_1, C_2 . . .

W is the component of the wind pressure which falls on the upper ring of rollers. This acts in the direction of the radius MA.

$\alpha = A_1MA = A_2MA_1 \ldots = C_1MC = C_2M_1C_1 \ldots$ the angle at the centre of the polygon.

$\phi = A_1AB_1 = AB_1B$ (fig. 1), the angle which the diagonals form with the horizontal plane.

Z = the tension in the diagonals of that rectangle (of the framing) which is parallel to the direction of the wind.

$t = Z\cos\phi$, the horizontal component of Z (see fig. 4).

$V = Z\sin\phi$, the pressure on the standards.

Δ is the linear expansion from elasticity which the tension Z causes in the diagonals.

$\delta = \Delta\cos\phi$, the horizontal projection of this linear expansion.

Z_n is the tension in the diagonals of the nth rectangle.

$t_n = Z_n\cos\phi$, the components in the horizontal direction.

$P_n = 2\,t_n \sin {}^1/_2\,\alpha$, the force acting radially.

$V_n = Z\,(n+1)\sin\phi$, the vertical components—that is, the vertical pressure in the standard between the nth and $(n+1)$th rectangle.

T_n is the total horizontal tension in the girders of the nth rectangle.

A_n is the tension in the foundation-bolts between the nth and $(n+1)$th rectangle.

E is the component of the weight of the guide-framing itself which falls on the guide-columns.

In the right-angled triangles ACD, $A_1C_1D_1$ . . . (fig. 2)—

$$AC = A_1C_1 = \ldots A_nC_n \ldots = \Delta\cos\phi = \delta \quad (1)$$

$$\left.\begin{array}{l}\text{Angle CAD} = {}^1/_2\,\alpha \\ \text{Angle } C_1A_1D_1 = {}^3/_2\,\alpha \\ \text{Angle } C_nA_nD_n = (n + {}^1/_2)\,\alpha\end{array}\right\} \quad (2)$$

$$\left.\begin{array}{l}C\,D = \delta\sin {}^1/_2\,\alpha \\ C_1D_1 = \delta\sin {}^3/_2\,\alpha \\ C_nD_n = \delta\sin (n - {}^1/_2)\,\alpha\end{array}\right\} \quad (3)$$

Since the lengths CD, C_1D_1, . . . C_nD_n, . . . are proportional to the tensions acting on the diagonals, therefore—

$$\left.\begin{array}{l}Z_1 = Z\sin {}^1/_2\,\alpha \\ Z_2 = Z\sin {}^3/_2\,\alpha \\ \ldots = \ldots \\ Z_n = Z\sin (n - {}^1/_2)\,\alpha\end{array}\right\} \quad (4)$$

* By "independent," it is presumed the author means, unrestricted by wire ropes or other devices for preserving the bell horizontal, so that it depends simply upon the ordinary guide-framing to prevent tilting; or it may mean not enclosed in a house.—F. S. C.

† In all the diagrams accompanying the paper, the word "*Feld*" should be translated "rectangle" or "bay."—F. S. C.

‡ That is, the curbs to which they are fixed are absolutely rigid and unyielding.—F. S. C.

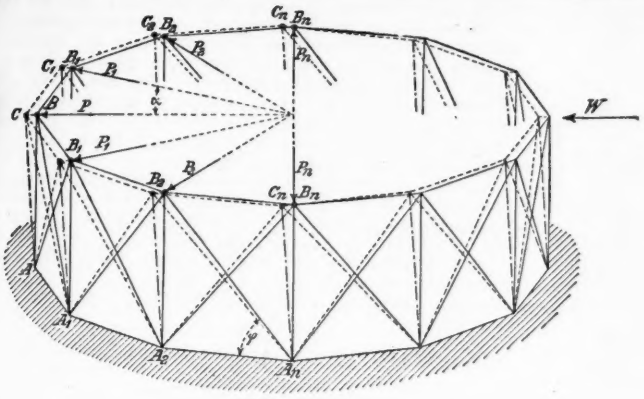


FIG. 1.

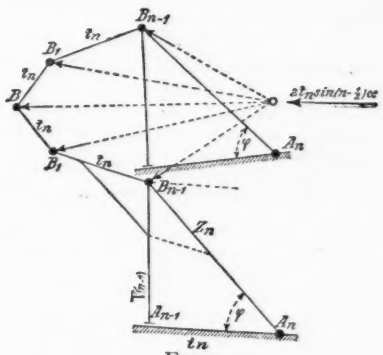


FIG. 3.

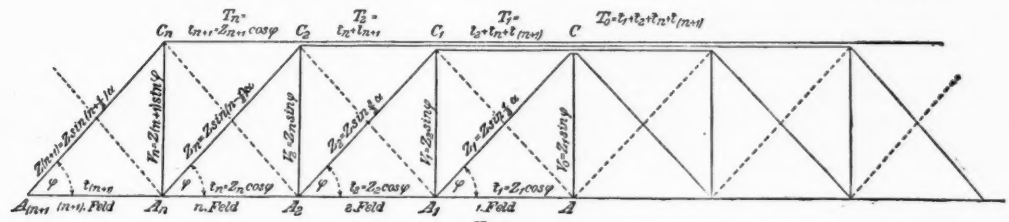


FIG. 4.

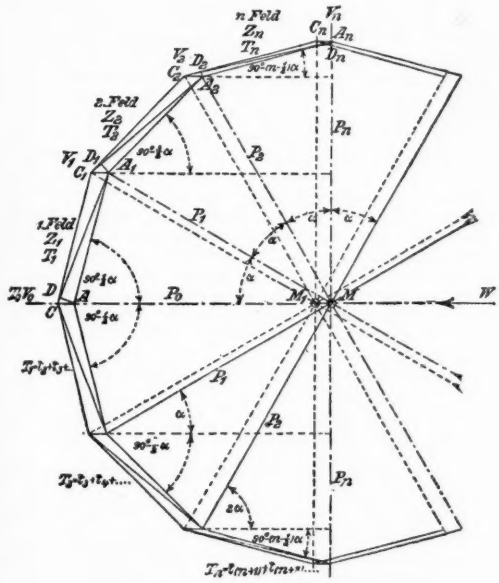


FIG. 2.

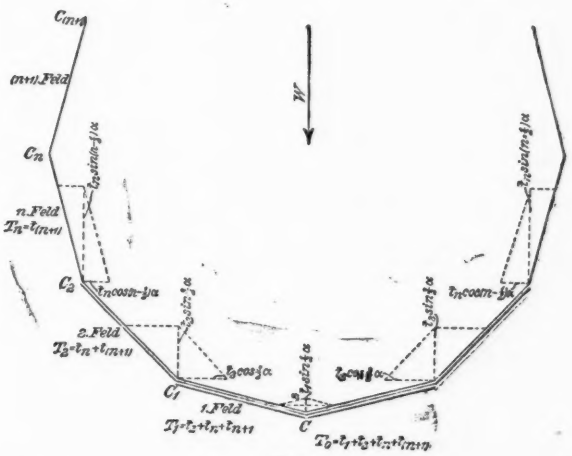


FIG. 5.

Since $t_n = Z_n \cos\phi$, therefore—

$$\left.\begin{aligned} t_1 &= t \sin {}^1/_2\,\alpha = Z \cos\phi \sin {}^1/_2\,\alpha \\ t_2 &= t \sin {}^3/_2\,\alpha = Z \cos\phi \sin {}^3/_2\,\alpha \\ \dots &\quad = \dots \\ t_n &= t \sin (n - {}^1/_2)\,\alpha = Z \cos\phi \sin (n - {}^1/_2)\,\alpha \\ \dots &\quad = \dots \end{aligned}\right\} \quad (5)$$

If the forces $t_1, t_2, \dots t_n \dots$ are in turn resolved into two components, one at right angles and the other parallel to the direction of the wind (fig. 5), the parallel components are—

$$\left.\begin{aligned} t_1 \sin {}^1/_2\,\alpha &= Z \cos\phi \sin^2 {}^1/_2\,\alpha \\ t_2 \sin {}^3/_2\,\alpha &= Z \cos\phi \sin^2 {}^3/_2\,\alpha \\ \dots &\quad = \dots \\ t_n \sin (n - {}^1/_2)\,\alpha &= Z \cos\phi \sin^2 (n - {}^1/_2)\,\alpha \\ \dots &\quad = \dots \end{aligned}\right\} \quad (6)$$

Since the sum of these components must be equal to half the wind pressure, we have—

$$W = 2\,Z \cos\phi\,(\sin^2 {}^1/_2\,\alpha + \sin^2 {}^3/_2\,\alpha + \dots \sin^2 (n - {}^1/_2)\,\alpha + \dots) \quad (7)$$

and, by transposing,

$$Z = \frac{W}{2 \cos\phi\,(\sin^2 {}^1/_2\,\alpha + \sin^2 {}^3/_2\,\alpha + \dots \sin^2 (n - {}^1/_2)\,\alpha + \dots)} \quad (8)^*$$

Since W, ϕ, and α are known quantities, Z can be calculated from them as soon as it is determined how many diagonals are stretched at the same time, and therefore how many must be taken account of. In order to be able to make this determination, the rest of the forces acting in the system must first be ascertained. The tensions $Z_1, Z_2, \dots Z_n \dots$ are taken up at the lower ends of the diagonals by a rigid fastening by means of the foundation-bolts. The upper ends of the diagonals, on the other hand, have the tensions taken up by the following parts: The vertical guide-columns, the horizontal girders of the rectangle and of the adjacent rectangle, and the radially-set roller on the bell. The roller of the gasholder bell exercises a pressure backwards estimated by the resistance offered by the diagonals. The tension Z_n which prevails in the nth diagonal must be resolved into the two following components:—

$$V_{(n-1)} = Z_n \sin\phi \quad (9)$$

and

$$t_n = Z_n \cos\phi \quad (10)$$

(See figs. 3 and 4.) The first component is transmitted as a pressure acting vertically downwards, and is of importance for the calculation of the guide-columns as regards freedom from fracture. The second component t_n would act on the horizontal girders of the nth rectangle, if the action which the tension Z_n of the diagonal causes, falls in the plane of the nth rectangle. Since, therefore, this action results from the roller pressure p_n in the direction of the radius of the holder, for producing equilibrium in the $(n-1)$th rectangle, the force t_n must recur. The roller pressure amounts to—

$$p_n = 2\,t_n \sin {}^1/_2\,\alpha \quad (11)$$

At the next $(n-2)$th corner of the polygon, there are again only the next horizontal girders and the radial roller pressure; for the counter-diagonals of the rectangle cannot take up com-

* When all the diagonals are taken into account, equation (8) becomes simplified to $Z = \frac{2W}{n \cos\phi}$ because generally $\sin^2 \alpha = \frac{1 - \cos 2\,\alpha}{2}$ and because $\sum_0^{360^\circ} \cos 2\,(n - {}^1/_2)\,\alpha = 0$.—NOTE BY AUTHOR.

pressional strain—all the diagonals being arranged for tensional strain only. It thus follows that, to take up the forces originating in the tension of the diagonal in the nth rectangle, the horizontal force

$$t_n = Z_n \cos \phi \qquad (12)$$

and the radial pressure of the roller

$$p_n = 2\, t_n \sin {}^1/_2\, \alpha \qquad (13)$$

recur in each rectangle, until a diagonal is found which takes the tension t_n downwards. This diagonal is first found on the other side of the middle axis AM in the rectangle of the second half of the gasholder with respect to the same, lying symmetrically to the nth rectangle (figs. 2 and 3). In this last rectangle there is also an opposing force to the radial roller pressure p_n, which is under the angle $n\alpha$ and is inclined against the direction of the wind, equal to it, and disposed symmetrically to the middle axis AM.

There are thus opposed to the forces Z_n, t_n and p_n equally great forces on the opposite side of the middle axis, and the forces t_n and p_n recur on both sides of the middle axis in all rectangles from the first to the nth (see figs. 3, 4, and 5).

In the $(n-1)$th rectangle, and in all the remaining rectangles up to the first, the same is the case with the forces occurring therein as in the nth rectangle; so the total forces are t_1, t_2, . . . t_n . . . and $p_1, p_2, \ldots p_n \ldots$ On the contrary, there are the forces Z_1, Z_2, . . . Z_n . . . V_1, V_2, . . . V_n, . . . each carried separately to the foundation.

The following forces come into consideration (see figs. 4 and 5):

$$\left.\begin{array}{llllll} \text{In the } n\text{th rectangle} & Z_n & V_{(n-1)} & t_{n+1} & p_n \\ \quad (n-1)\text{th} & Z_{(n-1)} & V_{(n-2)} & t_n & p_{(n-1)} \\ \quad \ldots & \ldots & \ldots & \ldots & \ldots \\ \quad \text{second} & Z_2 & V_1 & t_3 & p_2 \\ \quad \text{first} & Z_1 & V_0 & t_2 & p_1 \\ \text{At the point C} & — & — & t_1 & p_0 \end{array}\right\} \qquad (14)$$

Let the nth rectangle be the last in which a diagonal is in tension, or in which we can take account of the strain of the diagonal. There are then the following forces:—

$$\left.\begin{array}{llllll} \text{In the } n\text{th rectangle} & Z_n & V_{(n-1)} & — & p_n \\ \quad (n-1)\text{th} & Z_{(n-1)} & V_{(n-2)} & t_n & p_n + p_{(n-1)} \\ \quad \ldots & \ldots & \ldots & \ldots & \ldots \\ \quad \text{second} & Z_2 & V_1 & T_2 & P_2 \\ \quad \text{first} & Z_1 & V_0 & T_1 & P_1 \\ \text{At the point C} & — & — & T_0 & P_0 \end{array}\right\} \qquad (15)$$

In these—

$$\left.\begin{array}{l} T_2 = t_3 + t_4 + \ldots t_{(n-1)} + t_n \\ T_1 = t_2 + t_3 + t_4 + \ldots t_{(n-1)} + t_n \\ T_0 = t_1 + t_2 + t_3 + t_4 + \ldots t_{(n-1)} + t_n \end{array}\right\} \qquad (16)$$

And likewise—

$$\left.\begin{array}{l} P_2 = p_2 + p_3 + \ldots p_{(n-1)} + p_n \\ P_1 = p_1 + p_2 + p_3 + \ldots p_{(n-1)} + p_n \\ P_0 = p_0 + p_1 + p_2 + p_3 + \ldots p_{(n-1)} + p_n \end{array}\right\} \qquad (17)$$

For the determination of the strength, we have the proportions obtained by inserting the foregoing values in equations (10), (4), and (11):—

$$Z_{max.} = Z \qquad (18)$$

$$V_{max.} = V = Z \sin \phi \qquad (19)$$

$$T_{max.} = Z \cos \phi \,[\sin {}^1/_2\, \alpha + \sin {}^3/_2\, \alpha + \sin {}^5/_2\, \alpha + \ldots \sin (n-{}^3/_2)\, \alpha + \sin (n-{}^1/_2)\, \alpha] \qquad (20)$$

$$P_{max.} = P_0 = 2\, Z \cos \phi \sin {}^1/_2\, \alpha \,[\sin {}^1/_2\, \alpha + \sin {}^3/_2\, \alpha + \ldots \sin (n-{}^3/_2)\alpha + \sin (n-{}^1/_2)\, \alpha] \qquad (21)$$

There now remain only the foundation-bolts to be calculated. Let E represent the portion of the dead weight falling on a guide-column, and A_n the pull of the holding-down bolt on the foot of the nth guide-column; then—

$$A_n = V_{(n-1)} - V_n - E \qquad (22)$$

And so from equations (9) and (4)—

$$A_n = Z \sin \phi \,[\sin (n - {}^3/_2)\, \alpha - \sin (n - {}^1/_2)\, \alpha] - E \qquad (23)$$

The pull on the foundation-bolt has only a negative value for the side not exposed to the wind; but on the windy side it may have a positive value. As, however, the difference—sin $(n-{}^3/_2)\,\alpha$ − sin $(n-{}^1/_2)\,\alpha$—is in most cases a tolerably small fraction, and the dead weight E, on the contrary, always has a very considerable value, there will often also be no pull on the foundation-bolt vertically upwards on the windy side. Since, however, the foundation-bolt must present sufficient strength sideways to resist the horizontal component of the tension of the diagonals, an excessive degree of safety, as far as the somewhat small vertical pull on the bolt is concerned, is always secured with ease. In order not to present too sharp a contrast with general practice, which, as a rule, provides very strong foundation-bolts, it is advisable to take as a basis for the determination of the strength of the holding-down bolts, the sum of the vertical components of the tensions of the diagonals reckoned according to equation (8) with the dead weight deducted, thus—

$$A = Z \sin \phi - E \qquad (24)$$

As a rule, very fair values for A will then result.

5.—Number of the Rectangles.*

We now have to return to the question how many of the existing diagonals must be taken into account for the calculation of the guide-framing. On the wind-sheltered side, we can at once assume that the whole of the guide-rollers exert pressure; and accordingly the whole of the diagonals there are strained. On the wind side, on the contrary, the upper guide-rollers, on account of the room for play of the rollers and the changes of form of the bell and of the framing due to elasticity, are off the guide-rails by a small space. Even if the ring of the polygon B, B_1, B_2 . . . (fig. 1), composed of strong bars, is pushed, as a whole, slightly in the direction of the wind, the diagonals on the wind side are not strained in the same degree as those on the sheltered side, owing to the absence of the radial roller pressure p_n. As an exact inquiry into the occurrences on the wind side would lead to great prolixity, it is advisable only to take into account, besides the diagonals of the side sheltered from the wind, those on the wind side next to them—*i.e.*, those diagonals lying immediately behind the middle on each side.

6.—Example.

With a dodecagon, applying equation (8) we have—

$$Z = \frac{W}{2 \cos \phi \,(\sin^2 15^\circ + \sin^2 45^\circ + \sin^2 75^\circ + \sin^2 105^\circ)} \qquad (24)$$

Thus—

$$Z = \frac{W}{2 \cos \phi \,(0{\cdot}067 + 0{\cdot}500 + 0{\cdot}933 + 0{\cdot}933)} \qquad (25)$$

$$Z = \frac{W}{4{\cdot}86 \cos \phi} \qquad (26)$$

In the denominator, the values $\sin^2 135^\circ$ and $\sin^2 165^\circ$ have been neglected. There is thereby a discrepancy of $2\,(0{\cdot}500 + 0{\cdot}067) = 1{\cdot}13$, on taking account of which we have—

$$Z = \frac{W}{(4{\cdot}86 + 1{\cdot}13) \cos \phi}$$

That is, in this case, an amount for Z smaller by about 20 per cent. than it would be by equation (26)

7.—Explanatory Remarks.

In the foregoing calculations, a very important influence, which can be determined only with great difficulty, is left out of account. This is the give in the roller-carriages fastened to the bell, and in the gasholder bell itself. The bell consists of an inner skeleton of framed iron, and an outer skin of thin sheet-iron, which latter is only attached to the former at the bottom and top rings of the internal framework. The top is domed. The gas pressure in the bell causes a greater tension in the crown plates than in the side plates. There arises in the lowest zone of the crown, and thus at the angle, a very considerable force, to which the curb and the attached plates must offer resistance. The crown plates being strongest in the vicinity of the curb, they with it and the roof rafters abutting against it, and stretched by their own weight, make together a combination well fitted to maintain its original form. The projecting roller-carriages, however, have not always such rigid parts at their points of attachment that springing may be ignored. The long roof-rafters are, as a rule, united to the vertical posts by inclined struts.* On account of the great length of these parts, and the pressure falling on a point which is removed some distance from the curb, there must be produced a yielding of the roof rafters and struts.

The change of form also which the bell undergoes through the wind pressure, by being pressed from its circular to a somewhat elliptical shape, is difficult of estimation by calculation. This alteration of form can, however, exert but little influence, as a girdle is formed by the strong bars of the guide-framing BB_1, B_1B_2 . . . of which the circumference cannot be considerably increased. The guide-rollers on every ring are consequently forced to remain in a circle of which the diameter is the same for all the rings. By uneven distribution of the forces, the parts intimately concerned yield until the less concerned parts are affected. If the bell is forced by the wind to an oval shape, the effect of the force is greatest where the greatest flattening ensues—that is, in the middle of the side sheltered from the wind, where the straining of the diagonals is the slightest; and so an increase of this tension is desirable.

In order to value the effect of the stretching of the horizontal girders BB_1, B_1B_2, . . . which has been hitherto neglected, we have to consider that this stretching is caused by the pressure of the rollers acting radially. The points C, C_1, C_2 . . . therefore are moved radially farther outwards than they would be without the stretching in question. The lengthening of the diagonals which thus arises is equally large in all the rectangles for equally great radial forces P. It thus takes place to the smallest extent in those rectangles in which a great straining of the diagonals already exists. As now the forces P_1, P_2 . . . are the greatest where the diagonals are the least strained, a more equal distribution of the forces is brought about because the less strained diagonals undergo a somewhat greater strain.

Neglecting, therefore, the changes of shape of the gasholder bell due to elasticity and the stretching of the horizontal girders, and using for the static calculation of the guide-framing the simple formulæ Nos. 8, 18, 19, 20, and 21, no considerable error will result, provided the premisses on which the calculation is in the first instance based are approximately correct. To attain

* That is, bays of the guide-framing.—F. S. C.

* English gasholders have strong gusset plates uniting the rafters to the vertical stays; thus giving plenty of support to the roller-carriages and top curb. Long inclined struts are unknown in English gasholders; and they are useless appendages.—F. S. C.

this, the horizontal bars BB_1, B_1C_2 . . . are calculated for a lower straining of the material than the diagonals. The ordinary practice of making these bars, for the sake of appearance, as latticed girders, while the diagonals are simple rods in tension, is in accordance with this.

To make the full calculation of the guide-framing for practical use, it is necessary to determine the greatest strain on the standards as regards bending and cross fracture. The first is found when the guide-rollers are about half-way up. The wind pressure corresponding to this height is taken as W_1, and $\frac{W}{W_1} P_{max.}$ as the proportional pressure for the deflection. The breaking strength of the standards must satisfy the value $V_{max.}$ for the whole free length of the columns.

Calculation of the standards for torsional strength is unnecessary; there being, according to our assumption, no action on the side flanges of the guide-rollers. In practice, this assumption is often not justified. Old gasholders, with copious roller-flanges bearing evidences of considerable use, are found —a proof that there must have been a great deal of tangential pressure. But even when tangential pressure is present, the ordinary radial guides would offer sufficient resistance to be easily deflected so far sideways as to permit the rollers on the remaining guides to work accurately. The ordinary guides made of railway rails, fastened at wide intervals by weak rivets or screws to the guide-framing, are not sufficient for a serious tangential strain. As long as no fundamental change of construction is introduced, therefore, the consideration of the tangential forces may be postponed.

8.—Application.

The application of the foregoing must, in the first instance, be confined to simple single-lift gasholders. But it may be employed in the calculation of the guide-framings of telescopic gasholders. As a rule, these are formed of two or more tiers of lattice-work set on one another. The assumption that the lower ends are fastened in unvarying rigidity is no longer correct for the calculation of the diagonals of the upper stages. If, however, a somewhat rough approximation suffices, then the results obtained can be directly applied to the calculation of guide-framing consisting of two tiers one above the other, making the required resolutions of forces according to the conditions of each case. For a telescopic gasholder with a guide-framing in two tiers, the upper diagonals may be calculated roughly according to equation (8), and the lower given thrice the strength; or the lower tier of the frame may be calculated from the resultant of the wind pressure at the middle ring of rollers, the upper part of the frame being ignored. For exact calculations, the peculiarities of each case must be taken into account; and to attain results agreeing with facts, it is always necessary to make a number of assumptions as to the constructional parts.

9.—Conclusion.

The reason for the foregoing calculations was more especially the need for an additional lift to an old gasholder on an old cracked tank, and the erection of a guide-framing thereon which should depend as little as possible on the firmness of the masonry. The methods of calculation already published, and the actual methods of constructing the guide-framing of independent telescopic gasholders, differ greatly from one another, and are often entirely opposed. Hence arose the question of stating as clearly as possible what actually happens to an independent gasholder when the wind presses on it. It is evident that this object is not yet quite attained; but the goal must be aimed at, as the cost of the erection of gasholders is very great, and further economy must be secured every year in response to the demand for cheaper gas.

In reply to the letter of a correspondent to the Editor of the *Journal* of the Association, Herr Niemann states further that it is questionable if play in the roller guides conduces to the durability of a holder, as the play permits the bell to be driven to and fro by the wind, with the infliction of shocks that set up great strains. As long as other minor influences—such as the yielding due to the elasticity of the bell and roller-carriages—are left out of the calculation, it only complicates it, without attaining appreciably more exact results to introduce the consideration of the amount of play. In recently erected gasholders, scarcely any play is allowed; and though this requires very exact construction, it has become the rule in the erection of gasholders in Germany. There is no necessity for play, since the slightly varying temperature of the water in the tank prevails at the lower rollers, and changes of temperature produce nearly equal dilatation in the framework and bell at the upper rollers. The effect of any great casual pressure of the guide-rollers is mitigated by the flexibility of the roller-carriages and of the bell. Considerable play, having attendant disadvantages, is often found in old gasholders with massive framing.*

It is advisable, pending the establishment of an exact method of calculation, to be content with simple formulæ, and to use them merely as adjuncts to the experiences gained in practice, such as in the construction of the large gasholders in English works. These gasholders have weathered storms for some years; but their different methods of construction make them, to a great extent, unavailable for the inception of static calculations. The publications of G. Livesey,* B. Baker,† and F. S. Cripps‡ show that they rely on practical experiences and considerations, and avail themselves of comparatively simple calculations. The stability of the Old Kent Road holder built in 1881 has been indisputably proved by its use with the bell at the full height in the most violent storms.

* There is no large gasholder in existence (having two or more lifts) which has the *top* rollers pressing equally against the guides all round the circle, or even touching them throughout the entire circle, when the holder is fully inflated. Contraction due to the compression on the top curb when the holder cups the various lifts, is the cause of this (see "The Guide-Framing of Gasholders," p. 53).—F. S. C.

* "The Principles of Gasholder Construction." See Journal, Vol. XXXIX, p. 1189; also Trans. Gas Inst., 1882, p. 46.

† "The Structural Strength and Stability of Gasholders." See Journal, Vol. XXXVII., p. 141.

‡ "The Guide-Framing of Gasholders," by F. S. Cripps, Assoc. M.Inst.C.E. London: Walter King; 1889.

THE RECOVERY OF BYE-PRODUCTS IN THE MANUFACTURE OF COKE.

The Semet-Solvay Coke-Ovens.

The interesting Inaugural Address delivered by Colonel Sadler, J.P., of Middlesbrough, at the recent meeting of the North of England Gas Managers' Association (see *ante*, p. 694), and the visit of the members to the Malton Colliery to inspect the Simon-Carvès coke-ovens there, have combined to lend fresh interest to the subject of the recovery of the residuals of coke manufacture. We therefore extract from an article by Mr. J. H. Darby, in the *Ironmonger*, the following particulars as to the Semet-Solvay ovens, which are largely employed in Europe and America; and it may be pointed out that a letter on this subject from the same gentleman appears in our "Correspondence."

The ovens are built in a block of masonry, shaped into a series of arches, resting upon supporting side walls. In the interior of the chambers thus formed are built the flues, which have thin side walls. The supporting walls are from 16 to 20 inches thick; the thickness of the sides of the channel bricks which transmit the heat for coking the fuel is 2¾ inches. The interior dimensions of the ovens are as follows: Length, 30 feet; height, 5 ft. 6 in. The width varies according to the quality of the fuel to be treated, and must be determined for each particular case. For fuel containing only a small percentage of volatile material (say, 15½ to 17 per cent.), it is 14 inches; and for fuel very rich in volatile material (say, 25 per cent. or above), it is 16½ inches. To obtain the best results from the combustion of the gas, and to arrive at an equal distribution of heat in all parts of the oven, which ensures the regular and rapid coking of the charge, all loss of heat must be avoided. With these objects in view, the covering is made very thick over the chambers—in some cases as much as 4 feet. Double sheet-iron doors protect the cast-iron doors at one end of the ovens against the cooling influence of the weather. The in-draught of air into the ovens is also carefully avoided. The doors are so made as to permit of easy and effective luting; and all other openings—such as the charging-holes and the cleaning-holes in the ascension-pipes—are closed by plates with faced joints, which are kept tight by springs in such a way as to avoid the necessity for luting by clay. The batches of coke after leaving the oven do not present any trace of combustion or burning, which proves that the ovens are air-tight. The gaseous products of the distillation leave the ovens by the openings into the hydraulic main, where the gas from the various ovens unites, and where the temperature is quickly reduced by water, in order to avoid the deposit of hard tar in the pipes and apparatus. From the hydraulic main the gas passes through the condensing apparatus, and is then forced back to the ovens by the exhauster; passing on its way through the different washing apparatus, where it is relieved of its bye-products. In the ovens, part of it is burnt in the side flues, to provide the necessary heat for coking.

Part of the gas enters into the upper range of the side flues at the back or side of the ovens nearest the ram; passing successively along the intermediate and lower flues, and descending from the last-named into the flues under the hearth of the oven. The second supply of gas, introduced from the front or discharging side of the ovens, enters the middle flue. This division of the gas is intended to provide against the great local heating that would take place if it were all introduced at one point, and so to apportion the heat in a more uniform manner. The air necessary for the combustion of the gas is preferably heated in the flues placed under the hearth. This air is drawn by the chimney, and has to travel these heated flues before it is admitted at the point of combustion with the gas in the side flues of the ovens. The heating of the air is carried to 200° to 300° C.; and in this way part of the heat which would otherwise be lost in the hearths of the ovens is recovered. A special arrangement provides for the introduction of the gas for combustion in even quantities, and equalizes the quantity for each oven. Dampers regulate the communication between each oven

and the main flue for collecting the waste gases; and they are opened to such an extent that the draught of the chimney is equal in effect upon each oven. The gas for combustion in the side flues is regulated by the pressure in the distributing-main; and the air, by the damper at the base of the chimney in connection with the main flue. From the collecting-flue the products of combustion are conducted under boilers, and afterwards passed away into the chimney. When the temperature of the waste gases at the base of the chimney does not exceed about 200° C., the ovens are very hot and in good working order.

Only a portion of the gas produced in coking is necessary for heating the ovens. The quantity available for disposal varies, of course, according to the quality of the fuel used. With coal lean in volatile material—that is to say, containing from 15½ to 17 per cent.—the excess of gas is never less than one-fourth of the total given off in the ovens. The proportion of the excess of gas greatly augments as the volatile material in the fuel increases. With rich coals, containing 25 per cent. and more of volatile material, there is a surplus of upwards of half the gas made. The combustible gas not utilized in heating the ovens can be employed for any other purpose. The constancy or otherwise of the quantity of gas for disposal after condensation and washing is a good indication as to the way in which the ovens are working with regard to economy of heat. When treating fuel containing 15½ to 17 per cent. of volatile matter, there is usually 4½ per cent. of water and 1½ per cent. of tar, which is condensed. There remains, therefore, 9½ to 11 per cent. of volatile material for use in heating the ovens.

With regard to the economic value of the ovens, this may be appreciated from the following figures. The ovens proper, with the auxiliary apparatus, cost about £376 each, at Belgian prices. The charge per oven is from 4 to 5 tons of fuel; and the coking operation takes less than 24 hours. The filling and discharging of the ovens must be continued day and night without interruption. A regular and surplus supply of gas is thus obtained—the ovens being discharged as soon as the coking operation is finished. It is possible to gain 3 or 4 ovens per battery—that is, with 25 ovens, 28 charges at least can be obtained in 24 hours. The yield of coke is at its maximum through the non-admission of air into the ovens. At works treating coal containing 15½ to 17 per cent. of volatile material, the yield of coke is, on an average, 81 per cent. The coke obtained is absolutely the same as that produced from good ovens without plant for the recovery of the bye-products; and the cost of labour is practically the same in each case. With a battery where the products are recovered, additional hands are necessary for driving the gas-exhauster and for maintaining and cleaning the apparatus. As a set-off against this, the larger and more regular production per oven reduces the cost of labour at the ovens; and this advantage compensates for the extra cost attendant on the recovery of bye-products. The quantities of these vary, of course, with the character of the fuel used. Considerable economy is realized by using, for the purpose of raising steam, whatever gas is not required for heating the ovens.

A few particulars may be added as to the history of these ovens. The first trial of the system was made by M. Semet in 1882, at one of the pits of the Western Colliery Company of Mons, Belgium. He there erected a small battery of six ovens, and experimented with them for about a year. The advantages of the system being thus demonstrated, MM. Solvay et Cie. put up 25 ovens near the Havré Collieries, in order to continue the trials. Eventually the Company owning the collieries took over the ovens for their own use; and since then great developments have taken place. At the present time there are, in this country and on the Continent, eleven installations of the system, comprising 492 ovens at work; the total production of coke per annum being 596,500 tons.

Mr. John Bowen, Assoc.M.Inst.C.E., Borough Surveyor of High Wycombe, and Engineer to the Water-Works Committee, has been recommended to fill the office of Borough Engineer and Surveyor in the room of Mr. A. E. Collins, who has gone to Norwich. The appointment will have to be ratified at a meeting of the general Council.

Coal in New South Wales.—The annual report of the Department of Mines and Agriculture of New South Wales for 1893, recently issued, shows that the output of coal during last year exhibited a decrease of 502,640 tons compared with 1892, and in value of £290,666. The value of the output for last year is the lowest for the past 11 years; and the average rate obtained per ton, which was 7s. 1·78d., is the lowest for the past 13 years. The number of collieries under inspection on Dec. 31, 1893, was 97 coal and 4 shale, compared with 101 coal and 5 shale at the corresponding date in 1892. The actual number of men employed in and about the collieries during 1893 was 10,413, compared with 10,910 in 1892. A very valuable discovery of coal was made last year at Cremorne, Sydney Harbour, by means of the Government diamond drill, at a depth of some 2930 feet. At that depth a seam of good steam coal was struck, 10 ft. 3 in. thick, 9 ft. 2 in. of which is workable. An important effect of this discovery is that it may now be regarded as proved that the seam in question extends from the Newcastle to the Illawarra district.

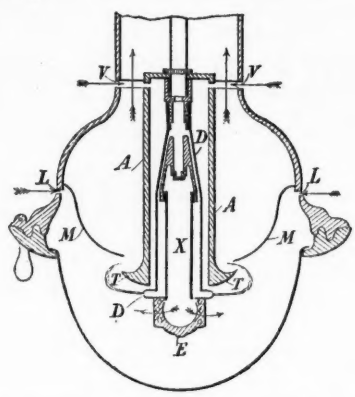
REGISTER OF PATENTS.

Gas-Motor Locomotives.—Holt, H. P., of St. Bride Street, London. No. 20,677; Nov. 1, 1893.

This invention relates to gas-motor locomotives or cars, so arranged that the pressure of the gas stored for consumption in producing motive power is utilized for working the brake apparatus. For this purpose, the reservoir in which the gas is stored at a pressure of several atmospheres is connected to a small brake reservoir through a reducing valve, so that the pressure in the reservoir is so far above atmospheric pressure that when gas from it is, by the movement of a valve, admitted into a brake cylinder, to act on a piston connected to the brakes, the brakes are put on with sufficient force. The brakes are taken off by a back movement of the valve, by which the gas that operated on one side of the piston is allowed to pass from that side to a larger space at the other side—thus putting the piston in balance as to pressure, and thereupon the brakes are taken off by a suitable spring. From the space into which the gas had thus expanded, there is a passage to the supply-valve of the engine; and when the brake is not in operation, the engine is supplied through a reducing-valve, preferably from the brake reservoir. The patentee prefers to pass the brake piston-rod through a flexible diaphragm, which covers the end of the brake cylinder, and which at its middle is attached to the piston-rod. The diaphragm is bulged out when the brake piston is moved to put on the brakes; and this increases the space beyond the piston into which the gas expands when the brakes are taken off.

Regenerative Gas-Lamps.—Greene, T. A., and Walker, C. M., of Cannon Street, E.C. No. 20,762; Nov. 2, 1893.

This invention is claimed by the patentees as "a development of, and an improvement upon, Young's invention described in patent No. 567 of 1854, and is adapted to burn in the open air when protected by a case or covering, and also for domestic and other uses without such cover or case."



The lamp is preferably made of cast iron, with the central tube generator A cast in one piece with the body of the lamp. The body is formed at its upper part as a collar, into which the chimney is fitted. It is provided with radial passages V for air. The gas-supply pipe passes downwards through the chimney, and is firmly fixed by back-nuts, at the lower of which the burner D is attached. This is constructed with a central air-passage X, terminating in an air-box E below the burning point, perforated with holes. The lamp is provided with a hinged ring or door fitted to receive a lipped glass; the upper face of the ring being provided with a beading, which fits into a corresponding recess or matrix in the under part of the body of the lamp, and is also fitted with an ordinary catch or fastening. A circular deflector M, with a central aperture, is provided inside the lamp, the upper part or fitting of which is immediately above the air-holes L. The addition of a circular shoulder T on the base of the generator is said to greatly increase the efficiency of the flame.

When the lamp is lighted and the hinged ring carrying the glass is closed, the draught in the chimney draws air through the radial air-passages V, part of which air flows down the centre of the burner and issues through the holes in the air-box E, and part passes down the annular space formed by the outer wall of the burner and the inner wall of the generator, and issues at the mouth thereof. The effect of these two currents of air is to feed the inner and outer surfaces of the flame with heated air; and this causes the flame to assume its proper form. Air also enters through the holes L.

Coal-Conveyors.—Ruscoe, J., of Hyde. No. 21,325; Nov. 9, 1893.

In the manufacture of conveyors for coal, coke, or other materials—whether of the pan or scraper type—it has hitherto been customary (says the patentee) to form a chain of links of suitable construction, and attach thereto either the conveyor pans or scrapers; the operative parts being thus distinct from the driving or actuating chains. This is objectionable, more especially in that a twisting strain is exerted with more or less leverage upon these parts. The present invention, therefore, is designed to construct such conveyors with the operative parts so connected together as to obviate the use of the carrying chains, and to themselves take the place of the chains. This imparts a central pull along the whole length of the conveyor.

For tray or pan conveyors, there would be pivoted upon a spindle two, three, or more brackets, free to move upon or rotate about its axis; and on each end of the spindle (either attached to it or free to rotate upon it) is a roller. The inventor prefers to use one central bracket and two side brackets on each spindle; and to these brackets the trays or pans are attached. Between each pan or tray a similar spindle and brackets are placed; and to these the trays or pans are attached—thus

forming a joint or hinge between each. The rollers and the ends of the spindles travel in slides or guides.

As applied to scraper conveyors—that is, a series of scrapers working in the bottom of a trough—the scrapers are formed with two wings or side arms, and with two longitudinally extending arms or links. The front and rear arms are provided with journals or sockets, to receive a spindle which passes through and connects each pair together; or the arms may be attached to brackets loose upon the spindle, as described. The ends of the spindles are provided with rollers to engage with the driving-wheels.

Retorts for Distilling Shale or Oil-Yielding Minerals.—Gray, J., of the Pentland Works, Loanhead, N.B. No. 21,485; Nov. 11, 1893.

This invention relates to an existing arrangement of retorts for distilling shale or other oil-yielding minerals, in which the retorts are heated by means of gases or vapours obtained from coal heated in separate retorts, combined with the other retorts in the same bench or building—there being usually one coal retort to every four shale retorts. The objects of the invention are "to overcome certain defects of existing arrangements and to economize fuel."

In the coal retorts as at present in use, the gases and vapours evolved from the coal pass off at the lower parts of the retorts through ports into flues, in which they are ignited for heating the shale retorts and also the coal retorts. In consequence of the considerable height of the coal retorts, says the patentee, the vapours or gases formed at the upper parts are obstructed in their descent to the outlet ports by the mass of coal in the retorts; and, owing to their consequent pressure, they tend to leak wastefully and injuriously through the brickwork of which the retorts are constructed.

By this invention communications are made between the top of each coal retort and the lower part, so as to give the vapours or gases formed at the top free access to the lower outlet-ports. The vapours and gases thus introduced into the lower parts of the coal retorts are there subjected to great heat; and the present arrangement has the further advantage that the vapours or gases prevent, or very much diminish, the fluxing of the earthy matter of the coal and the formation of clinker. In the case of existing retorts, the communication between the upper and lower parts of the retorts or the general heating flues may be formed by external iron pipes; but in the case of new retorts, they may be either external iron pipes, or flues or passages formed in the brickwork.

Jointing Wrought-Iron Pipes.—Hodgson, J., of Sutton, Surrey. No. 21,967; Nov. 17, 1893.

This invention in pipe-joints consists in the combination of (1) a loose sleeve having bevelled and screwed ends, upon which ends screwed caps fit, bored to receive the ends of the pipes to be connected, two or more split metal rings engaging in grooves formed in the pipes; and (2) a packing-ring formed of india-rubber or like suitable material, and interposed at the junction of the ends of the pipes where they are bevelled.

Gas-Motor Cars.—Holt, H. P., of Manchester. No. 23,305; Dec. 4, 1893.

In his specification, the patentee remarks: "As in gas locomotives it is desirable to work the gas-motor engine at nearly constant speed, gearing of at least two proportions and suitable clutches have to be provided, whereby the car can be driven at either of two speeds; and it is also of the greatest importance that the motor should be free to work while the car is standing still, and may not have its speed reduced so much as to endanger its stopping, in order to avoid the delay and difficulty of starting it again." The present invention is designed to effect this in cases in which the car is driven by compressed gas carried in a reservoir, or compressed air for the purpose of vaporizing or spraying liquid fuel.

This is obtained by making use of clutches on the engine-shaft, or a countershaft driven by the engine-shaft, each of which consists of several plates or discs arranged side by side. The first, third, &c., plates revolve with the shaft; the alternate plates—the second, fourth, &c.—revolving with the boss of a toothed wheel, which is free to revolve on the shaft. Both sets of plates can slide a little longitudinally. The first plate is pressed on by a flexible diaphragm, covering the face of a recessed disc fixed on the shaft. The recess of this disc behind the diaphragm communicates, by a bore in the shaft, with a valve (under the control of the driver), by which it can be put in communication either with the reservoir of compressed gas or with the gas supply-pipe of the engine. When compressed air is used, the recess can be put in communication with the reservoir of compressed air, or with the atmosphere.

There are two sets of these clutches, acting on two wheels of different diameters, gearing with wheels on a parallel countershaft. The valve above mentioned may be either a slide-valve or a partially rotating valve governing suitable ports. In one position it is arranged to cut off both of the clutch discs from communication with the gas or air reservoir, relieving the pressure on both of the diaphragms, and consequently leaving both sets of plates loose, so that neither of the wheels on the countershaft is driven. In another position of the valve, one diaphragm is relieved from pressure, but the pressure is made to act on the other diaphragm pressing the adjacent plates closely together, so that the one wheel is loose and the other wheel is driven and drives the parallel shaft at the one speed. In the third position of the valve, the other clutch is brought into action, driving the parallel countershaft at the other speed. In this way the pressure of the gas or air is made to work the clutches, and may still be used in the engine.

Gas Cooking-Stoves.—Toope, C., of Stepney. No. 11,164; June 8, 1894.

The patentee declares his object to be to produce "a cheaply constructed but efficient gas cooking-stove and oven, whereby the heating power of the flame may be applied economically and with little waste of heat, either for boiling or partly for boiling and partly for baking purposes at the same time; the oven being so applied to the stove that it may be removed therefrom at will." Such ovens as heretofore usually constructed have been heated by internal gas-jets; but this "improved" oven is heated entirely by external heat, so conducted through the external flues as to ensure a sufficient top heat for browning the article cooked in the upper compartment of the oven.

The stove consists of a heating chamber supported upon angular corner pieces or legs united to a base; the top of the chamber having (say) three apertures, over which cooking vessels may be heated by atmospheric gas-burners rising from a common supply-pipe through corresponding apertures in the bottom of the chamber. The chamber is connected by an outlet-flue at or near one end of it with a chimney, to carry off the products of combustion, and to create the necessary draught through the flues. The oven is surrounded with double walls at the top, bottom, sides, and back, to form heating flues. The bottom of the oven rests on the top of the stove, and has an inlet aperture with downwardly-projecting flange adapted to fit in the aperture of the stove, and an outlet aperture with downwardly projecting flange fitting in another aperture in the top of the stove in immediate proximity to the outlet-flue. The inlet and outlet apertures are completely separated by a division-plate, which separates the flue space at the bottom of the oven into two parts. The part of this flue space into which the inlet opens communicates with the side flues, which communicate in turn with the top flue space. In this flue space are fixed two baffles leading from the rear corners to the middle of the top of the oven, so as to prevent the hot gases rising through the flues passing too directly to the back flue with which the top flue communicates, and ensure a more uniform distribution of the heat over the oven top. The back flue is thus entirely separated from the side flue, except through the top flue; the gases, on passing through the gap between the baffles, flowing down the back flue to the outlet aperture, and thence through the flue to the chimney.

Manufacture of Carburetted Water Gas.—Pearson, W. H., of Toronto, Canada. No. 15,107; Aug. 7, 1894.

This invention relates more particularly to means and devices for heating and vaporizing oil or liquid hydrocarbons, and superheating steam, before converting them into carburetted water gas. The principal object of the invention is to utilize the heat from the hydrogen or water gas for heating and vaporizing the oil or hydrocarbons, and also for superheating the steam before using it in the generator, thereby obviating the waste of oil or liquid hydrocarbons and fuel, and obtaining more perfect carburation of the water gas.

Fig. 1

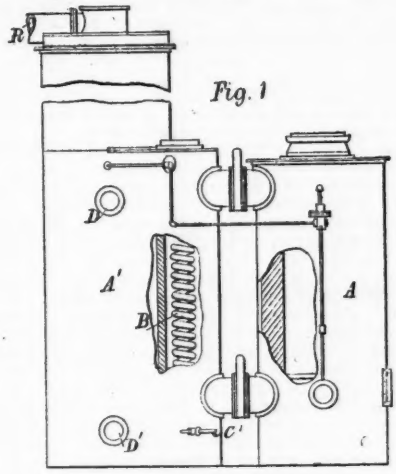


Fig. 2.

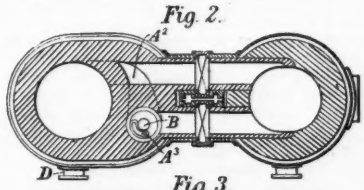


Fig. 3.

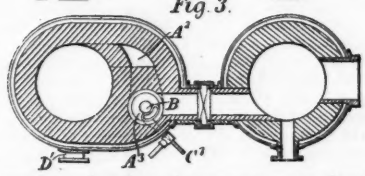


Fig. 1 represents an elevation of a generator, superheater, and fixing chamber. Fig. 2 is a cross section of the top, and fig. 3, of the bottom of generator. Fig. 4 [next page] is a detail view of the coils in elevation, with part of the outer coil broken away. Fig. 5 is an elevation (partly in section) of two generators, showing the plan for connecting them.

A is a generator, of the usual construction; and A^1 a superheater or fixing chamber, having a flue A^2 and passage-way A3. The flue has no connection at its top with the superheater; but it is connected at its lower end with the lower part of the superheater by a flue, and at its upper end with the upper part of the generator by another flue having a valve for closing it. The passage-way A3 is connected at its lower end with the superheater—preferably by a horizontal branch connecting with the bottom of the flue A^2, as shown in dotted lines in figs. 2 and 3. This passage-way is connected with the generator by an upper gas exit-flue and valve leading from the upper part of the generator, and a lower gas exit-flue and valve leading from the lower part. The lower valve is closed when the upper one is open; and the gas

passes down through the passage-way A3 into the bottom of the superheater. When both of the valves are closed, the gas passes into the lower part of the passage-way A3, and then into the bottom of the superheater; and at the same time it fills the passage-way A3 with the heated gas. It is in this passage-way that the patentee prefers to place the oil or liquid hydrocarbon heater or vaporizer and steam superheater B, as the oil and steam can be heated by the hydrogen or water gas before the latter comes in contact with the oil or liquid hydrocarbon, and thereby the deposition of any carbon on the pipe or pipes forming the combined vaporizer and superheater is prevented. This is accomplished by placing the part B at some point between the place where the water gas is made, and before it reaches the superheater or fixing chamber. The point shown in figs. 1, 2, and 3 is that preferred; but it may be placed in various other positions—for example, in the gas-flue connecting the two generators, as in fig. 5.

Fig. 4.

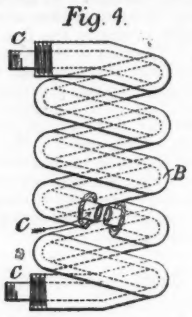
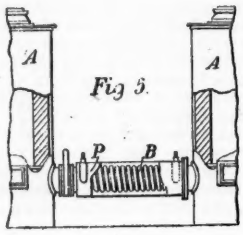


Fig 5.



Separate pipes are used for the oil and steam; and they are preferably of different diameters, so that one may be enclosed in the other. In the device shown, the oil-pipe C is enclosed in the steam-pipe, and both are coiled to get the greatest heating surface in the least space. The combined device is supported in the passage-way, and the ends project preferably outside the walls of the superheater A^1, so that the pipes may be properly branched. The oil-pipe is connected with an oil supply-pipe C^1; having suitable cocks (not shown) for regulating the flow thereto. It passes upwards until it projects outside of the superheater, and is connected with the pipe which supplies hydrocarbons to the superheater A^1 in a gaseous form, owing to the heating they have received in their passage through B. By thus heating and vaporizing the oil, a vapour instead of oil is projected into the path of the heated water gas, which will more readily absorb the vapour, and thereby prevent the waste of oil as is the case when the liquid hydrocarbons are projected into the superheater.

The steam passes upwards through the coil, and is taken from the latter by a pipe leading from the superheater A^1 to the generator A. This pipe terminates in two branches, leading respectively to the top and bottom of the generator, into which they enter. The pipes are provided with cocks for cutting off the supply of steam to the top and bottom of the generator; so that, when steam is passed in, the pipe leading to the opposite end is closed against the passage of steam.

The operation of the apparatus is as follows: Fuel is introduced into the generator, the proper valves being closed and opened. A blast of air is then introduced at the bottom of the generator, and forced up through it. The producer gas thus formed is allowed to pass into the superheater and fixing chamber A^1. Here air is again introduced, preferably at two different points D D^1; and combustion is effected, heating up the superheater and fixing chamber in the ordinary way. When the fuel in the generator is sufficiently ignited, and the refractory material in the superheater and fixing chamber is adequately heated, all the air-blasts are shut off. Steam is then introduced into the coil of pipe in the passage-way A3, and passes up through it to the generator, where it enters underneath the body of fuel. Passing up through it, the gas formed enters the gas exit-flue and passage-way A3, where it comes in contact with the coil which contains the steam, thereby highly superheating the same. Oil or liquid hydrocarbons are at the same time introduced into the coils C, and pass up it, and enter the superheater or fixing chamber, where they are instantly vaporized and diffused with the highly superheated water gas. Both gases then pass on through the superheater and fixing chamber, and out through the pipe R.

When the heat in the generator ceases to decompose the steam, the oil or liquid hydrocarbons and steam are shut off, and the relative valve closed and opened. The air-blasts are then turned on again; and the temperatures are raised as before described. When the heat is sufficiently increased to again decompose the steam, the air-blasts are shut off, and steam is then introduced into the coil of pipe in the passage-way A^3, and passing out to the generator and then through the fuel is converted into water gas. The water gas passes from the generator into the bottom of the superheater and fixing chamber, and fills the passage-way A^3. Oil or liquid hydrocarbons are then introduced, as before described, where they are instantly vaporized and diffused with the highly superheated water gas. Both gases then pass on through the superheater and fixing chamber, and out through the pipe R into the washers, scrubbers, condensers, and purifiers.

Fig. 5 shows an elevation of two generators coupled together by a pipe or flue P. Contained in this pipe is a coil similar to the one previously described. In working two sets of apparatus together when making water gas, steam is alternately passed down through one generator and up through the other; and it then passes on through the superheater and fixing chamber, as before described. Oil or liquid hydrocarbons and steam are passed through these coils in the manner previously explained.

Detecting and Measuring the Presence and Amount of Inflammable Gases or Vapours Mixed with Air.—Tilghman, B. C., of Philadelphia, U.S.A. No. 15,453; Aug. 14, 1894.

Alluding to his proposals, the patentee says: It is well known that, if a thin wire or strip of metal be arranged so as to be heated to a suitable temperature by proper means—as by an electric current of suitable quantity passing through the strip—if there are any inflammable gases or vapours in the air surrounding the wire so heated, these inflammable gases will be burned on the surface of the heated wire. The wire will consequently be heated by the burning of the inflammable gases, and the passage of the electric current, to a higher temperature than the passing of the electric current alone would effect; and the increase in heat in the wire has a fixed relation to the amount of gas present in the surrounding atmosphere. It is also well known that certain metallic conductors—as, for instance, platinum—increase their electrical resistance on an increase of temperature, and in a fixed ratio to this increase of temperature. Therefore, by properly arranging a circuit, including a suitable wire or strip of metal, so that it will be carried into places where the condition of the air is to be tested, passing a suitable current of electricity through it, and measuring the increase of resistance due to inflammable gas (if any occurs) over the normal resistance of the circuit due to the passage of the electric current alone, the amount of inflammable gases can be ascertained, and that, too, without the necessity of the observer going to the place to be tested. By this process also the indications given are positive, and do not in any way depend upon the judgment of the person making the test, but may be read off in percentages of inflammable gas in the air. The present invention consists in a method of operation designed to accomplish this end; in a special form of galvanometer designed to be used in connection therewith; and also in an arrangement of the apparatus so that it may be compact and portable.

APPLICATIONS FOR LETTERS PATENT.

18,575.—Taylor, G. H. and Waller, C. B., "Gas-fired steam-boilers." Oct. 1.

18,614.—Clark, W., "Gas and oil engines." Oct. 2.

18,789.—Cumming, M., "Regulating the light of street, stair, factory, and other gas lamps or burners." Oct. 4.

18,794.—Brown, J. F., "Gas-fires, grill-burners, and cooking-stoves." Oct. 4.

18,896.—Fletcher, T., Russell, W., and Messrs. Fletcher, Russell, and Co., Limited, "Atmospheric gas-burners." Oct. 5.

18,926.—Armstrong, J., "Combining and burning gas with atmospheric air." Oct. 5.

18,959.—Wigham, J. R., "Illuminating buoys and beacons." Oct. 6.

18,992.—Doulton, H. L., and Manger, A. W., "Softening waters and purifying waste liquors." Oct. 6.

19,003.—Pickering, A. W., "Manufacturing gas of illuminating and combustible properties." Oct. 6.

19,085.—Muller, A., "Absorption of gases by liquids, and cooling gases." Oct. 8.

19,102.—Houghton, G., "Artificial lighting apparatus." Oct. 9.

19,112.—Clerk, D., and Lanchester, F. W., "Gas and oil motor engines." Oct. 9.

19,130.—Courtenay, R. H., "Rendering the combustion of coal gas more perfect." Oct. 9.

19,285.—Luis, M. V., and Elgood, E. C., "Electric or [and] gas chandeliers." A communication from L. Priebe. Oct. 10.

19,293.—Mitton, J. L. and T. J., "Retort mouthpieces and self-sealing lids." Oct. 11.

19,343.—Abel, C. D., "Motor vehicles for railways and tramways driven by gas or oil motor engines in combination with electro-motors and accumulators." A communication from the Gas Motoren Fabrik Deutz. Oct. 11.

19,457.—Clapham, T., and Laycock, J., "Purification of coal or other illuminating gas." Oct. 13.

19,462.—Nichol, F. E., "Using incandescent gas-burners in places where vibration interferes with the mantles." Oct. 13.

19,500.—Macdonald, R. M., "Motors applicable to tramcars and the like." Oct. 13.

The Filtration of the Keighley Water Supply.—New works for the filtration of the water supply of Keighley were inaugurated last Tuesday. There has been some trouble in the borough in past years with cases of lead-poisoning; and the Corporation have spared neither effort nor expense in attempts to check this. After much inquiry, the Water Committee recommended the adoption of the "polarite" system. Three beds, about 30 ft. by 12 ft., were laid down and charged with this material, in order to arrest the organic matter before the water flowed into four capacious shallow sand filters, covering an area of 5480 square yards on a terrace below. From these the purified liquid was to flow at the rate of 2,180,000 gallons per diem—using three filters, while the fourth was resting—into a clean water basin, covering 1345 square yards, and holding 1,060,000 gallons. The filter works were commenced in April, 1893. On a preliminary trial of the "polarite" beds in conjunction with one of the sand filters, it was found that, while the water had gained in purity and hardness, the latter quality had quite disappeared after passage through a sand filter laid with 4 feet of material in layers ranging from hand-packed rubble to fine sand. The second filter was therefore differently made up; the floor being laid with bottom limestone layers, topped with gravel and sand. This experiment proving satisfactory, the other sand filters have been charged in a similar way. But this success was qualified by a new and unlooked-for trouble. A green slimy coating formed on the surface of the "polarite" beds, and so choked the interstices of the mineral as seriously to interfere with its action. It was then decided to remove this expensive medium—costing about £6 per ton, but renewing its powers after exposure to the atmosphere—and replace it by Welsh anthracite coke, free from sulphur. The material was recently reported to be giving satisfaction for its screening, and, to some extent, purifying properties. New "polarite" beds were constructed between the sand filters and the clean water tank, where the "polarite" will have a better chance of imparting a characteristic brilliance to a liquid already twice filtered. From time to time the filter-beds will require cleansing; and arrangements have been made in the bottom of each bed for the use of Walker's patent conical washing machines. The original estimate of the cost of the filtering works was £11,000; but it has reached to about £16,000.

CORRESPONDENCE.

[We are not responsible for the opinions expressed by correspondents.]

Compressed Gas v. Gasholders.

SIR,—In an issue of the JOURNAL some months back, a writer signing himself "Engineer" touched upon the possibility of supplying ordinary gas from cylinders containing gas under pressure, instead of through the medium of the costly and cumbersome gasholders now in vogue. Personally, I have been for some time very much fascinated with this idea; and I should be glad if "Engineer" or anyone professionally interested in the matter would kindly communicate with me, or discuss the question in the columns of the JOURNAL, as I am in a position to carry out such an experiment on a large scale.

Oct. 16, 1894. ANGLO-DANE.

The Semet-Solvay Coke-Ovens.

SIR,—In your issue of the 16th inst., there is an article on "The Recovery of Bye-Products in the Manufacture of Coke." As considerable interest seems to be evinced at present in the relative methods of the different systems of retort coke-ovens before the public, it may be interesting to know that the Semet-Solvay ovens referred to in the article, and which are most largely used in Belgium, are coking a very dry coal, containing only 14½ to 17 per cent. of volatile matter. This accounts for the comparatively low yield of sulphate of ammonia and tar given in comparison with the Otto-Hoffman and other systems, which are almost exclusively employed in coking a far richer coal.

As an instance of the results obtained by the Semet-Solvay ovens when working on a rich coal, I give the following, obtained at the works of the Brymbo Steel Company, Limited. At present the production of sulphate of ammonia is 1·2 per cent., and of tar 5 per cent. of the fuel treated. This is superior to anything I know of, and will, I anticipate, be increased. Also the production of coke per unit of time and the yield of coke per ton of fuel charged are far above the results obtained with any other system.

It may interest your readers to hear that the spare gas from the Semet-Solvay ovens is alone used for lighting the works, offices, and houses belonging to the Brymbo Steel Company, Limited. The fuel employed is slack or "smudge," washed and ground.

Brymbo, Oct. 20, 1894. JOHN H. DARBY.

MISCELLANEOUS NEWS.

LABOUR TROUBLES AT THE PLYMOUTH GAS-WORKS.

Attempts to Wreck Plant.

The Plymouth Gas-Works have been the scene of a series of startling occurrences during the past fortnight. For some eight or ten days after the new machinery recently erected there commenced to work, everything went smoothly and satisfactorily. Trouble then began to be experienced; and difficulties of the most unexpected kind have constantly occurred ever since. On more than one occasion, the heats in the new retort-stack were so tampered with that the make of gas fell off to an alarming extent. Pieces of iron, shovels, and other things, found their way into the coal-breakers in mysterious fashion. The water supply to the new washer-scrubbers and to other parts of the works was turned off at unexpected times; and the gas now and again went out in part of the new works. To use the language of Mr. John West with reference to the occurrences, everything that subtle ingenuity and scientific knowledge could suggest was done to hinder the smooth working of the plant. The people concerned in these attempts to place obstacles in the way of the Company were, however, not content with such comparatively innocent measures. Proceeding to greater lengths, they attempted last week to wreck one of the gasholders—the largest on the works—and actually succeeded, by interfering with one of the governors, in throwing part of the town into temporary darkness.

That the whole trouble is the direct outcome of the labour question is apparent from a consideration of the course of events since the new plant was installed at the works. All the old stokers were members of the Gas Workers' and General Labourers' Union. The introduction of machinery has led to the displacement of about thirty of these, and has also enabled the Company to dispense with the assistance of the extra hands who have hitherto been taken on for the winter. Another consequence of the change of system has been the introduction of men who are not connected with the Union. During the erection of the plant last summer, a number of labourers were required. The West Gas Improvement Company found skilful and willing hands amongst the Plymouth men who applied for work, many of them having been engaged on board ship, and possessing the handiness which becomes natural in the sailor. When the machinery was erected and ready for work, these men were offered, and willingly accepted, positions as minders of the machinery. As labourers, they had been getting 22s. to 24s. for a week of 54 hours. While they were being taught to manage the machinery, they were employed for 12 hours a day; but since then they have been put on eight-hour shifts, and are paid the same rate as the other stokers—viz., 5s. a day, with time-and-a-half for Sunday labour. These are Trade Union hours and conditions. The men are, however, not members of the Union. At the outset, they asked Mr. West—who will have charge of the new plant until it gets into thorough working order—whether they were expected by him or by the Company to join this organization. To this the reply was that they might please themselves. They had not, they were told, been asked whether they were unionists or not, any more than they had been invited to say what their political or religious views were. They could become members of the Union if they pleased; but that was no condition of their employment, and any attempt to coerce them into joining it would be resisted. So far as is known, the whole of these men abstained from becoming members of the Society. While they were employed alone, the work went on smoothly. But as more of the new retort-benches were finished, the retorts in the old part of the works were laid off, some of the stokers were discharged, and others were transferred to the new retort-house, to open and close the lids, auger pipes, and do other necessary work. Then began the series of little annoyances already alluded to. All the dampers of the regenerative furnaces were repeatedly altered, and the whole of the calculations and observations which had been made and taken, with the object of ascertaining the "pull" of the chimney and the exact regulation of the heats, were rendered useless. The make of gas also went down. Although the annoyances were systematic, and were designed with much skill, the management bore them with patience and apparent equanimity. So far they had led to no actual damage; and as it was impossible to detect the authors of the mischief, the only thing to do was to increase the precautions where possible, and to double the watchfulness, so as to prevent the risk of still more serious consequences ensuing.

Matters remained in this state until yesterday week. On the previous day (Sunday), Mr. H. Townsend, the Engineer and Manager of the works, found that the largest holder, which has a capacity of 750,000 cubic feet, had grounded, and all the three lifts were down. As the position was unusually favourable for greasing the pulleys, he directed two of the men to do this. On Monday morning, Mr. Townsend again went to look at the holders, and, on walking round this particular one, found two large stones so placed as to threaten the structure with serious damage. One was on the middle cup, and the other was tightly wedged in between the cup and the outer lift. It was afterwards suggested that they might have fallen from a wall near at hand, or got there by other accidental means. But, although there are plenty of stones about the yard—for both excavation and building are still in progress—the position in which these were found, and the tightness with which they were wedged into position, precluded the idea of accident. When the discovery was made, the top lift was up, and the middle lift was then cupping. Mr. Townsend stopped the working into the holder; and when some of the Directors visited the works that morning, the matter was put under their notice. An investigation of the circumstances by these gentlemen led to the summary dismissal of the two men who had been engaged in greasing the pulleys of the holder on the previous day. At a meeting of the Board on Thursday, it was decided to offer a reward of £100 for information which will lead to the conviction of the authors of the outrage; and notice has since been given of this by advertisement in the local papers. When the Directors came to this decision, they had before them an application from the local Secretary to the Gas Workers' Union. This person asked the Board to receive a deputation from the Union as to the dismissal of the two men, and a further deputation from the Union and their own workmen as to certain grievances of the stokers. Both of these requests were at once refused.

Thursday night added another to the series of troubles. This time the public suffered temporary inconvenience, for at about a quarter to ten the pressure of gas in the houses of what is known as the Cattedown district suddenly failed, and in many instances the lights were actually extinguished. Two railway stations—the Friary Terminus of the London and South-Western Railway Company, and North Road Station, which is owned by the Great Western and South-Western Company's jointly—are in the district affected. The mischief was, however, so quickly rectified that no serious injury resulted. The fact that something was wrong was first brought to the notice of the people in the works by the failure of the supply to the new retort-house. At the same time, a foreman who was leaving the works noticed that the lights were dying out in the street-lamps; he and the Manager at once went to the governor-house and found that someone had wilfully opened the water-tap of the governor which regulates the supply of gas to the district in question. As the result, the water had run off, and the supply of gas was stopped. In a very few minutes, the governor was put right again, and the supply restored. But, like many other incidents which have occurred, this particular piece of mischief seems to have been the outcome of deliberate design. It could only have been done by someone having intimate knowledge of the works and of the probable effect of the action. Whether the design was simply to throw the new retort-house into darkness, so as to stop the machinery, or as a prelude to further mischief, can only be imagined. However, as the public convenience and safety were now threatened, the Directors decided to apply for police protection; and since Friday constables have been stationed at the works, with a view to the prevention of further tampering with the plant.

Both the local papers refer to the seriousness of the outrage. The *Western Morning News* advises the men who have been displaced and those who are acting as their advisers that "nothing but evil can result from any attempt to damage the machinery or to satisfy a feeling of revenge by destroying the property of the Company who introduced it." It goes on to say: "The machines have come to stay; and no effort on the part of the men will oust them, or lead to a reinstatement of the old conditions. As it has always been in the past, acts of violence will recoil with tenfold force upon those who are so wicked and so stupid as to perpetrate them. While sympathy will be felt for the men thrown out of work, it cannot be forgotten that the Gas Company owe a duty to the public which they are bound, at any cost and at any risk, to discharge. The personal comfort, the safety, and in many cases the absolute means of livelihood of the people of Plymouth are largely identified with a full and constant supply of artificial light. Gas has, in fact, become almost as great a necessity of life as water; and the Gas Company will have the support of public opinion in any measures they may be forced to take to secure the continuance of its supply."

THE NEW WORKS OF THE PLYMOUTH GAS COMPANY.

Complaints of Nuisance.

The completion of the extensions for the Plymouth Gas Company has been followed by a complaint from residents in the neighbourhood that the works are a nuisance. As was explained in our account of the inaugural ceremony (*ante*, p. 608), the Company have practically added new works to their old plant. One effect of this has been to transfer a large proportion of the manufacturing process from one side of their land to the other. The new retort-house is close to the easterly boundary of the Company's property, on land which was until a year or two ago used for agricultural purposes; while the old retort-houses are from 100 to 200 yards away on the westerly side. This change has apparently proved anything but agreeable to the owners and occupiers of a number of houses in the vicinity, some of which are only separated from the new retort-house by the width of a road which gives access to the works, while nearly all are in line with the direction of the generally prevailing wind. On Monday last week, a deputation of the persons aggrieved waited upon the Borough Council. They were introduced by Mr. J. T. Bond; and they presented a petition, in the course of which they stated that every time the retorts were charged, there was emitted from the works "a dense volume not only of smoke, but of a fine black, sandy deposit," which penetrated their houses, destroyed their furniture, and entailed incessant labour to keep the places clean. Life in the houses was, it was asserted, rendered "almost unbearable." The petitioners then went on to say: "Those of us who own property are receiving notice upon notice from our tenants that they must leave. Those of us who reside near the works will be driven farther away. So far as the nuisance is an actual damage to those of us who are householders, we must, of course, seek the protection of the law. But, as ratepayers, we ask that our public authorities shall give this most serious complaint their immediate attention, with the view to the abatement of a serious public nuisance." It was stated that the petition was signed by 140 owners and ratepayers, of whom 40 are resident owners. Two members of the deputation—one owning 45 and the other 36 houses—said their tenants complained strongly of the nuisance. The deposit from the gas-works was described as resembling fine coal; and it was said to completely cover the articles in the houses and other buildings in the neighbourhood. It was also said that the nuisance had arisen only since the introduction of the new machinery at the gas-works, and that no complaint had been made to the Company by those who were aggrieved. Alderman A. S. Harris thought the deputation had taken the wrong course, and should have complained to the Company before approaching the Council. Mr. Bond remarked that the Medical Officer of Health had paid a visit to the gas-works; and the matter was really a serious one. It greatly affected the Company, who had lately invested considerable capital in extending the works and in new machinery. He was sure the Company would do what they could, and as soon as possible, to abate the nuisance. Alderman J. Wills, a Director of the Company, said he wished the complaint had been made direct to them, because he knew it would be the desire of every Director and shareholder to abate any nuisance that might be caused to residents in the neighbourhood of their works. The Company were, he was certain, sorry that any inconvenience or annoyance had been occasioned. He would take care that the matter was brought to the notice of the Directors; and any measures which could be adopted to abate the nuisance would be taken. The Mayor (Mr. W. Law) also gave the assurance that the matter should receive the attention of the Sanitary Committee. With these promises, the deputation withdrew.

Steps have since been taken to reduce the cause of complaint. In order to prevent the smoke and fumes from the retort-house being carried directly over the neighbouring houses, the openings in the east gable end of the building have been closed; a circular hole, high up in the gable has been bricked up; while square openings lower down have been temporarily filled with canvas and are to be glazed. In order to secure ventilation for the retort-house, openings have been made in the roof; and as the smoke and fumes will now be given off at a greater height, it is hoped that the disagreeable consequences of which residents in the vicinity complained will no longer be experienced.

INCREASED STOREAGE AT THE BRISTOL GAS-WORKS.

Inauguration of the Barton Hill Gasholder.

The new gasholder which has for the past two years been in course of construction for the Bristol Gas Company at Barton Hill, on the east side of the city, and of which some particulars were given in the JOURNAL when recording the proceedings in connection with the commencement of the tank in November, 1892, was formally inaugurated last Thursday, when a considerable party—including Directors of the Company, members of the Corporation, and other leading citizens, accepted the invitation of the Chairman (Mr. J. W. S. Dix) to witness the starting of this the latest addition to the Company's plant. The holder is not only the largest in the West of England, but ranks seventh among the important gasholders in this country. Both it and its tank were designed by Mr. G. C. Trewby, M.Inst.C.E.; and the work has been carried out, by Messrs. C. and W. Walker and Messrs. John Aird and Sons, under the supervision of the Company's Engineer (Mr. W. Fiddes). The holder, which is of steel, is 220 feet in diameter and about 690 feet in circumference. It has three lifts, each 50 feet deep; and its capacity is 5½ million cubic feet. It is surrounded by 25 lattice standards, joined by diagonal tie-rods. The guides are V-shaped, of ½-inch hydraulic pressed steel; the rollers, also of steel, acting both radially and tangentially. The work as it stands is a striking example of lightness and strength combined. When the holder was tested with air, observations were made during a severe gale; but the level of the vessel was unaffected. The total weight of the structure is 1303 tons; and it has cost about £58,000. The tank, of which the first stone was laid by Mrs. Dix on Nov. 8, 1892, is 222 ft. 6 in. in diameter, and 50 feet deep from the rest-stones to the top of the coping. The walls are 5 feet thick at the bottom, tapering to 3 feet at the top; the intermediate space being filled with concrete.

The guests having assembled, the Secretary of the Company (Mr. J. Phillips) handed the Chairman a golden key bearing the following inscription: "Presented to Alderman J. W. S. Dix, Chairman of the Bristol Gas Company, on his opening the large gasholder at the Barton Hill section. October 18th, 1894." With this key Mr. Dix unlocked a padlock, and, amidst cheers, turned a handle which opened the outlet-pipe through which the gas contained in the holder, filled to its utmost capacity, passed for use by the citizens. Subsequently the party repaired to the Company's offices at Canons' Marsh, where luncheon was served in the Board-room. Mr. Dix presided; the Mayor (Mr. R. H. Symes) and the High Sheriff being present. After the usual loyal toasts had been duly honoured, the Chairman proposed "The Contractors;" remarking that Messrs. Aird and Messrs. Walker—well-known names—had carried out their work in a splendid manner. Mr. J. Aird, M.P., and Mr. W. B. Featherstone (for Messrs. Walker) having replied, Mr. Percy Stothert proposed "The Engineers." Mr. Trewby, in responding, said he thought the Directors had shown great forethought in providing the holder just completed. The masonry was the most perfect piece of work he had seen; and the admirable way in which the holder had been constructed would prevent its being affected by the roughest wind that might blow. Mr. Fiddes also appropriately acknowledged the toast. Mr. J. H. Howell proposed "Success to the Bristol Gas Company." In doing so, he referred to the peace which now characterized the working of the concern, and bore testimony to their indebtedness to the Directors and their staff, who worked in complete harmony. As gas shareholders, they hailed the electric light as an adjunct and auxiliary of gas, and did not fear it at all. There was still much room for the development of gas; and that this was realized by the public, was seen from the high figure at which gas stock stood. The Chairman heartily thanked Mr. Howell for the kind way in which he had submitted the toast. The success of the Company had, he said, been somewhat exemplary; and it had been so for a long time. When they began, a gasholder was, he believed, put up which had a storeage capacity of 30,000 cubic feet. In a book dated 1819-20, he saw a description of a gasholder in Birmingham which would contain 30,000 cubic feet; and a note at the foot of the same page stated that there was at the Bristol Gas-Works one of 43,000 cubic feet capacity. To show how gasholders and the consumption of gas had expanded, he might mention that in 1860 the Company had four holders, with a combined capacity of 1,689,000 cubic feet; in 1870, there had been further additions—bringing up the storeage capacity to 5,503,000 cubic feet. In 1880, the works at Stapleton were added, which, together with an extra lift to a holder at Canons' Marsh, brought up the storeage room to 7,003,000 cubic feet. In 1890 and 1891, lifts were added to the first holder at Barton Hill and holders at Stapleton; and now they had just started their newest and largest holder, with a capacity of 5,500,000 cubic feet—bringing up the storeage power to 13,803,000 cubic feet. Their output was upwards of 8,000,000 cubic feet; and it sometimes reached 9,000,000 cubic feet. At the present time, they had sufficient storeage to last them for a few years to come, although they would be pleased if the increase in the demand for gas was such as to make it necessary for them to construct another holder within a short time. The tank in which the new holder stood had a diameter of 222 ft. 6 in., and a circumference of 700 feet, or about one-seventh of a mile. The depth of the tank from the coping was 50 feet; and the height of the holder was 150 feet from the coping, or 200 feet from the bottom of the tank. The wall of the tank at the bottom was 5 feet thick; and it was 3 feet at the top. The tank held 5¾ million gallons of water—about the same as the quantity of gas the holder would contain. That it was not a small undertaking, they would realize when he told them it required the removal of 35,000 tons of earth to form the tank. The "members"—to use the professional term—or pieces of which the lattice framing was constructed, taken lineally, would extend for a distance of upwards of 14 miles; and the riveting, similarly treated, would reach 12 miles. They had also made considerable strides in the mains. In 1864, their mains were 125¾ miles in length; in 1874, 171 miles; in 1884, 227¼ miles; in 1893, 267¼ miles. Between 1864 and 1893, there had been an increase of 142 miles. So far as the revenue of the Company was concerned, he would quote the following figures: 1854-5, £50,129; 1860-1, £64,746; 1869-70, £99,542; 1879-80, £170,239; 1889-90, £196,314; 1893-4, £268,534. This increase had been gradual, but satisfactory. They had no fear of the electric light. They did not suppose that their output would increase at the same rate as if there was no electric light; but they believed electricity was not going to get rid of gas. There was room enough for both. He had always said they could not keep out the electric light; still it was rather hard upon the Company that they should be asked, as large ratepayers, to assist a competing scheme carried on by the Corporation. However, he had no apprehension that the Company would be extinguished in their time; and, moreover, they did not mean that it should be extinguished. If by constant care and the exercise of fair ability, they could keep going, he was sure they would do it; and he had every belief that they would succeed. He then submitted "The Staff," remarking that they were not only efficient, but free from friction; and, as every business man knew, this meant a great deal for the success of any concern. Mr. Phillips replied, and remarked that it was a satisfactory feature that, while the revenue of the Company had gone up, the price of gas had gone down from 4s. 2d. to 2s. 8d. per 1000 cubic feet. There were two of the Company's employees who had over 50 years of service; five, over 40 years; ten, over 30 years; seventeen, over 20 years; and the average of twelve employees was 40 years. They had, therefore, those working for the Company who tried to do their duty, and were appreciated. The proceedings then closed.

The Public Lighting of Leeds.—At a meeting of the Lamp Committee of the Leeds Corporation last Tuesday, it was reported that 200 additional lamps had been erected in the streets during the past year, as compared with 154 in the previous year.

THE TECHNOLOGICAL EXAMINATIONS OF THE CITY AND GUILDS OF LONDON INSTITUTE.

We learn from the report of the Examinations Committee of the above-named Institute on the work of the past session, a copy of which we have received from the Superintendent of Technological Examinations (Sir Philip Magnus), that the number of classes registered was 853, and the number of students in attendance 25,718, as compared with 733 classes and 24,474 students in the session 1892-3. The total number of candidates examined was 11,631; being 1377 in excess of the previous year. There were 54 subjects of examination in technology, 9907 papers sent in by candidates, and 5481 passes. In "Gas Manufacture," 87 candidates went up, as compared with 49 last year—an increase of 38. In the Honours Grade, 8 candidates passed in the first class, 10 in the second class, and 9 failed; in the Ordinary Grade, 28 passed in the first class, 21 in the second class, and 11 failed. There were 67 passes and 20 failures; the latter being in the proportion of 22·9 per cent. of the total number of candidates examined. There were 49 students who passed for the first time; while 11, who had previously satisfied the Examiner, passed in a higher grade, and 5 gained a better place in the same grade—2 failing to improve their position. Reporting on the result of the last examination, Mr. Charles Hunt, M.Inst.C.E., states that the great increase in the number of candidates affords very satisfactory evidence of the growing appreciation in which these examinations are held; while the quality of the papers shows that the very large majority of the candidates are, in some way or another, engaged in gas manufacture. He says the papers in the Ordinary Grade were particularly good; and if those in the Honours Grade were of scarcely so high a quality, it was probably owing to the questions having been rather more difficult than usual. As already mentioned in the JOURNAL, Mr. Hunt has now completed his term of office, and has been succeeded by Mr. Alfred Colson, M.Inst.C.E., of Leicester. Mr. Hunt and his predecessor (Mr. Robert Morton) are now on the list of Consultative Examiners of the Institute. In the subject of "Coal Tar Products," the number of candidates was ten, of whom only four passed—these being in the first class of the Ordinary Grade; four failing in this grade, and two in the Honours Grade. The Examiner (Mr. Arthur G. Green) expresses his regret at having to report a considerable falling off in the standard of the answers sent in, although the paper set was somewhat easier than that for the previous year. The candidates for examination in "Electric Lighting" numbered 287 in the preliminary, and 402 in the advanced stage. Only 71 of the former, and 175 of the latter, failed; being in the ratio of 24·7 and 43·5 per cent. respectively. In the Honours Grade, 18 passed in the first, and 16 in the second class, and 16 failed; while in the Ordinary Grade, 76 passed in the first, and 117 in the second class, and 159 failed. In addition to the certificates given to the candidates, prizes are awarded to those who, showing sufficient merit, take the highest places in the examination in each subject. These prizes consist of sums of money placed at the disposal of the Institute by the different Livery Companies, and of silver and bronze medals given by the Institute. The number of prizes awarded this year has been 225, as compared with 218 in 1893. Of the former number, 193 were in money, amounting to £395 10s.; while 87 were silver, and 138 bronze medals. The work of the Institute now extends to all the principal towns in the United Kingdom.

GAS AND ELECTRIC LIGHT EXHIBITION AT STAFFORD.

An important exhibition of gas and electric lighting appliances, held under the auspices of the Stafford Corporation, was opened in the Borough Hall last Wednesday by the Mayor (Mr. G. Wormal). It was probably the most representative collection of gas apparatus seen in the Midlands for some time; the Corporation Gas Engineer (Mr. J. Ferguson Bell, Assoc.M.Inst.C.E.) having secured the co-operation of the most eminent manufacturers in the kingdom. There were 36 stands, the numerous articles displayed on which presented an attractive appearance. Gas-stoves were furnished by the Carron Company; the Davis Gas-Stove Company, Limited; Messrs. Doulton and Co.; Messrs. Fletcher, Russell, and Co., Limited; Messrs. A. Gibbs and Co.; Messrs. Arden Hill and Co.; Mr. F. H. Holmes; Messrs. R. and A. Main; Messrs. W. Parkinson and Co.; the Planet Foundry Company; Messrs. Richmond and Co., Limited; Mr. F. Siemens; Messrs. Charles Wilson and Sons; and Messrs. John Wright and Co., Limited. Gas lighting appliances were shown by Messrs. George Bray and Co.; the Incandescent Gas-Light Company, Limited; Mr. F. H. Holmes (who exhibited the albo-carbon light and Deimel gas-lamps); Messrs. D. B. Peebles and Co.; and Mr. F. Siemens. Meters, fittings, and other apparatus were provided by the Automatic Gas-Meter Company; Messrs. Carnaby and Co.; Messrs. W. and B. Cowan; the Gas Apparatus Company; Messrs. T. Glover and Co.; Messrs. Sawer and Purves; the Stafford Corporation Gas Department; Mr. J. Stott; and Messrs. A. Wright and Co. Gas-engines were shown by Messrs. Crossley Bros., Limited, Messrs. Keats Bros.; and Messrs. Rooper and Tozer. The last-named firm (a local one) had, in conjunction with Messrs. Crossley, a display of electrical appliances; as had also Messrs. Thorn and Co., of Stafford. A Tangye gas-engine, supplied and fixed by the Gas Committee of the Corporation, drove a dynamo supplying the electric light to Messrs. A. Wright and Co.'s exhibit. Messrs. Winfield, Limited, and Messrs. Evered and Co., Limited, had a good collection of chandeliers, hall-lamps, &c.; and the other exhibits comprised models of gas-works plant and various labour-saving and other appliances. Cookery demonstration lectures were given by Miss Dods, Principal of the Birmingham and Midland School of Cookery, twice daily. The exhibition remained open till Saturday. The attendance was very large, and great interest was displayed; while the general arrangements, in the able hands of Mr. Bell, left nothing to be desired.

THE NEWBURY CORPORATION AND THEIR GAS MANAGER.

The Question of "Extras" Revived.

A section of the Newbury Town Council seem to be reluctant to allow the question to rest as to the payment of the Gas Manager (Mr. R. M. Couper) for certain "extras" in connection with the extension of the works, to which reference has already been made in our columns. Mr. Couper's charges, it may be remembered, amounted to £139; and a cheque for this sum was handed over to him, and promptly cashed. Subsequently, however, it was thought that only £80 should have been paid to him for his additional services; and the outcome of the matter was that the Town Clerk was instructed to write and ask him to refund the balance. Mr. Couper naturally justified his claim; and, as his bill had been settled, he did not see why he should be called upon to pay back any portion of the amount to which he considered he was fairly entitled. He nevertheless expressed himself willing to have the matter arbitrated upon by a qualified gas engineer. This attitude appeared to arouse the indignation of some members of the Council; and, at the meeting of this body on Tuesday last, a motion was brought forward by Mr. Smith to the effect that, as Mr. Couper declined to return the money, notice should forthwith be given to him to terminate his engagement. In support of his motion, Mr. Smith said he did not bring any charge against Mr. Couper; but he certainly thought £139 was an exorbitant sum to pay him. The Council, in accordance with a resolution proposed by himself, settled that the amount should be £80; and to quietly absorb the whole of the profits realized by a year's working of the concern in giving a gratuity to an employee over and above this figure was a thing which he considered ought to be put a stop to. Mr. Withers seconded the motion. The Chairman of the Gas Committee (Mr. Lucas) characterized the bringing forward of the motion as a most unfair and unjust proceeding, as both its mover and seconder knew that the money had been handed to Mr. Couper without reservation. Mr. Smith had, if he might use the term, shouldered the Corporation blunderbuss, and asked them to present it at the head of the unfortunate Manager, with the threat—"Your money or your berth." In a long speech, he defended Mr. Couper, and spoke in high terms of his management of the works; stating that a saving to the consumers of the large sum of £11,000 had been effected by reductions in the price of gas and the allowance of discounts. In his opinion, if the motion were carried, a great injustice would be done to a devoted public servant. Mr. Midwinter, as the mover of the resolution by which Mr. Couper was appointed clerk of the works, said the extensions had been carried out for the estimated amount; and Mr. Couper's charge was a fair and reasonable one, which the Council ought to acknowledge. To make the Manager the scapegoat for the Gas Committee's proceedings was unfair, unmanly, and unjust. The Mayor (Mr. J. Elliott) took exception to some of the remarks of the two previous speakers as to Mr. Couper's capacity as a Gas Manager. Mr. Long said it was not a question of capacity or incapacity. They were asked to dismiss Mr. Couper for retaining money to which he was not entitled. He did not agree with the motion. If anyone was to blame, it was the Gas Committee; and to call upon the Manager to resign because he had money to which the Committee said he was entitled, was a reflection upon the Corporation. He thought Mr. Couper's suggestion for submitting the matter to arbitration presented a fair way of getting over the difficulty. After some further discussion, Mr. Harris moved, as an amendment—"That the consideration of Mr. Couper's position as Manager of the gas undertaking be postponed until the balance-sheet for the current year has been examined by the Council." This, however, was not voted upon; and the motion was lost by 14 votes to 9. The proceedings were marked throughout by a good deal of personality; the Mayor being charged by the Chairman of the Gas Committee with being a partisan. It is to be hoped that the question, which has caused very much ill-feeling, is now definitely settled.

ELECTRIC LIGHTING NOTES.

Mr. Shoolbred has been consulted by the Electric Lighting Committee of the Windsor Town Council regarding the application which they purpose making for a Provisional Order, to empower them to supply electrical energy in Windsor and Eton. He has presented the Committee with an exhaustive report on the subject. He places the capital outlay on the installation he proposes at £18,500. The expenditure on the profit and loss account he estimates at £1680; and the annual interest and sinking fund upon the capital expenditure will amount to £950, at 3½ per cent. The receipts, at 7d. per unit, will come to £2187; so that he reckons there will be a loss of £443 on the first two years' working.

The sum which the Portsmouth Town Council gave their Electric Lighting Committee authority to spend upon the installation for the borough was £60,000. Of this the Local Government Board have sanctioned the borrowing of £58,200; but beyond this amount, the Committee have expended £1600. They are now asking the Local Government Board to grant them permission to borrow the remaining £1800, which will then only leave them with the small sum of £200 in hand for immediate necessities. The Committee, according to the Chairman (Alderman Ellis), hope to pay their way on the first year's working. They have based their calculations on an average earning per lamp of £1 per annum. During the first (the summer) quarter—at the commencement of which some of the consumers were not connected—they earned £1000; but the newspaper report from which we have gleaned these particulars does not contain any information as to the expenses—these being (in Alderman Ellis's own words) "more difficult to work out."

In the presence of the members of the Town Council and others, the Mayor (Mr. G. Wormal) laid the foundation stone of the Stafford electric lighting station last Wednesday; the ceremony being performed with a silver trowel and mallet presented by the Gas Engineer (Mr. J. F. Bell). For the purpose of the works, the Local Government Board have granted the Corporation permission to borrow

£20,000; but it is proposed to spend only £15,000 at present. The contract for the buildings have been let to Mr. H. Lovatt, of Wolverhampton. In the dynamo-house, there will be three 120-horse power condensing horizontal steam-engines, each to drive a dynamo calculated to produce 300 ampères at 200 volts potential, with a speed of 600 revolutions per minute. In the adjoining boiler-house there will be three Lancashire steel boilers, 7 ft. 6 in. diameter and 28 feet long. Space is left in the dynamo-house for two more engines if necessary; and in the boiler-house, for four more boilers. The chimney-stack will be 135 feet high, with sufficient capacity to accommodate eight boilers. The supply will be on Dr. Hopkinson's three-wire system.

Concerning the unsatisfactory condition of the electrical cables at Londonderry, we learn that Messrs. Siemens Bros. have offered to relay one of the circuits which they have found is unable to stand the amount of insulation resistance mentioned in the specification. Questioned on the subject at a meeting of the Corporation Lighting Committee on the 11th inst., the Resident Engineer (Mr. J. Christie) stated that Messrs. Siemens had only so far tested one circuit; and it had not stood the test. He understood that they intended going over the four circuits. On the same occasion, a report was read from the Electrical Engineer (Mr. Blake) with reference to the striking out of the clause relating to the efficient test from the specification approved of by Dr. J. Hopkinson. Mr. Blake said the clause was, as Messrs. Siemens said, impracticable; but it had been inserted not by him, but by Dr. Hopkinson in his original draft specification. The intention was to keep the contractors up to the highest possible test. All the contractors, however, eliminated the clause. After much heated discussion, it was proposed that a deputation should have an interview with Messrs. Siemens and Dr. Hopkinson, with a view to seeing what was best to be done; but the meeting terminated without coming to a decision. It was reported, at the beginning of last week, that there had been no failures of the light for some nights previously.

The delay in getting the electric light started in Cardiff was again the subject of complaint at a meeting last Tuesday of the Corporation Committee having the project in hand. In a despairing tone, the Mayor (Mr. Trounce) asked how much longer the electric light would be "in getting on;" but no one seemed able to give him an answer. An indefinite one, however, was found in a report which was afterwards presented by the Consulting Electrical Engineer (Mr. W. H. Massey). "As soon as the contractors have finished their tests," he said, "the works may be started and formally opened." But he proceeded to call the Committee's serious consideration to the fact that the number of glow lamps wired for (as distinct from mere applications for the supply of current) was too small to warrant the use of the machinery at the station regularly night and day. The Mayor had no hesitation in asserting that the town was sustaining a heavy loss by this delay in starting. Many of the tradesmen who were ready for the light two or three months ago had been compelled to re-introduce gas on their premises. Some of the contractors had not carried out their contracts within the specified time; and he thought that the penalties should be enforced. The Borough Engineer (Mr. W. Harpur) did not agree that the town was losing heavily by the light not being run. If the current was turned on with only the present applications for it, the Corporation would lose at the rate of from £700 to £1000 a year. He seriously advised the Committee not to commence running until they had wired from 4000 to 5000 lamps for private consumers. At the present time, he did not think there were 500 wired; and unless they could get from 4000 to 5000, they would be working at a big loss.

In previous issues of the JOURNAL, reference has been made to the proposal entertained by the Adelaide City Council to adopt electric lighting in the city; and the matter has lately been occupying their attention. In view of the Council's action, a deputation waited upon the Surveyor (Mr. Langdon), and discussed the question with him. The strong point they raised against the scheme was that the Gas Company had offered to make a substantial reduction in the charge for gas, and that consequently this matter should receive serious consideration before a new system of lighting was adopted. The report of the Surveyor on this interview duly came before the Electric Lighting Committee of the Council; and it was decided to inform the deputation that no definite offer had been made by the Gas Company, who, however, had been communicated with thereon. It was acknowledged that the Company had notified that the price of gas to consumers in Adelaide and its suburbs and in Port Adelaide had been considerably reduced, and that they were prepared to arrange with the Council for the lighting of the public lamps in the city whenever so desired. The Committee's action was subsequently endorsed by the Council. After some correspondence had taken place between the Town Clerk and the Company, the latter submitted a definite offer in regard to the public lighting. It was to the effect that, if the Council would enter into a seven years' contract from Sept. 1, 1894, they would cancel the existing contract for the street-lamps, at a saving to the Corporation of £975, as well as reduce the future rate by £650 per annum. The detailed prices quoted were as follows: For the 804 small lamps, now charged at the rate of £5 14s. each per annum, it was proposed to charge £5; for 12 small lamps lit every night, the price would be reduced from £7 10s. to £6 12s.; for 50 single-burner Bray lamps, from £9 to £7 15s.; for three single-burner Bray lamps lit every night, from £12 to £10 4s.; for two triple-burner Bray lamps, from £24 to £20. This offer was considered by the Electric Lighting Committee, who recommended the Council to take a poll of the citizens upon the question of electric *versus* gas lighting for the public lamps, when the annual elections come on in December; and, in the meantime, to request the Company to keep their offer open until after the poll. When this recommendation came before the Council, Alderman Buik suggested that the report containing it should be referred back to the Committee. He held that, in the interests of the citizens, some effort should be made to see whether or not the Company would keep their offer open so long. Mr. Sellar thought the Council might well accept the offer for a term of (say) four years, as the Council were not in a position to indulge in expensive experiments. The matter might, he considered, easily be postponed for four years. In the end, the Committee's report was adopted. The settlement of the question now awaits the result of the poll.

GAS-PIPING FOR BUILDINGS.

A recent issue of the *Engineering Record* contained an article on the above subject, from which we extract the following remarks:—

There are few features of modern building construction which do not now receive thorough treatment when the design is fortunate enough to fall into the hands of competent architects and engineers; and yet there is one very important portion of the structural outfit, so to speak, of a building, which up to the present time receives no intelligent consideration whatever, except in very rare cases. We refer to the gas-piping of buildings of all classes. The gas companies have made practically all possible advances in processes of manufacture and distribution; and, in the main, the consumers have largely reaped the benefit of the resulting economies.

Municipal building regulations have in most cases prescribed fairly wise and reasonable general rules under which buildings and their various structural appointments are to be constructed; but on the question of running gas lines for proper distribution within the buildings, they have been essentially silent. Architects also virtually have turned over to gas-fitters, as a general statement, the whole question of fitting the buildings which come under their design and supervision. What ought to be everybody's business seems to have been nobody's; and consequently there probably has never been any portion of the construction and fitting of a building which has exhibited more ignorance and gross blundering than the general run of the gas-pipe plans of many structures now standing—and this is saying a great deal. As is almost or quite the invariable result in such matters, the purchaser and the consumer are the principal sufferers.

It certainly is not creditable to the architect or the engineer thus to fail to properly specify, or generally to specify at all, for so important a part of his work; and no municipal regulation can be considered as complete, either in its form or operation, unless it suitably covers a class of work which so immediately affects the comfort and health of almost every human being and the welfare of every business within its corporate limits. It is the legitimate desire, of course, of the gas-fitter to reduce to his client the total cost of his work to a minimum, and he gets it as the lowest bidder; hence the result is all but a universal decrease of size of pipes in a building far below those which ought to exist for a proper supply at the points of actual consumption. Besides, a lack of proper knowledge of design causes a very general, and sometimes an utterly absurd, disproportion between the main and running lines and branches, which results, in connection with the fundamental difficulties of small pipes, in excessive complaints from users in many instances, and in costly and inefficient, if usually unnoticed, illumination or heating, and very costly alterations and additions to the piping in the modern fireproof building. Indeed, it cannot be expected that gas-fitting will be done carefully and efficiently, or with materials and workmanship of excellent quality, unless, like other branches of mechanical work, it is done under intelligent specifications, faithfully executed.

Since the advent of high buildings with fireproof floors, and the demand for gas for cooking and heating has arisen, the embarrassment due to the causes cited have been more pronounced. In view, therefore, of the interests involved, the *Engineering Record* submits to architects and engineers, as well as municipal authorities, a general system of specifications and rules under which buildings may be fitted with gas-pipes, so as to produce the greatest excellence in design and the most efficient and economical use of gas. After a very thorough examination of the whole question, and many conferences with large firms of gas-fitters, engineers of gas-works, and others directly interested in the attainment of the desired end, the specifications, tables, and rules printed elsewhere have been prepared. These regulations have been made essentially to agree with the few best efforts which have already been made for the same purpose. They do not involve any conditions inconsistent with the best interests of gas consumers, producers, or fitters; but they have been based on such reasonable conditions as will secure in all respects the best practice to all those departments of gas interests. The tables showing the sizes required for the prescribed number of burners, logs, heaters, and ranges are founded upon a very careful and thorough investigation, both analytical and experimental, in regard to the flow of gas through the pipes of the maximum lengths indicated. The resulting sizes are in some instances a little larger than those hitherto prescribed; while in others they are not. But in all cases they will ensure the free flow of the necessary volume of gas; and thus entirely avoid the annoyances and loss due to too small pipes.

The following are the specifications and rules referred to in the preceding article:—

TABLE *of Maximum Lengths of Pipe and Number of Lights, with Corresponding Diameters.*

[The results in this table are based upon a specific gravity of ·6 and a pressure of gas of 0·5 inch of water.]

Diameter of Pipe, Inches.	Maximum Length, Feet.	Maximum Number of Lights.*
⅜	20	2
½	30	3
¾	40	6
1	60	10
1¼	70	15
1½	100	30
2	150	60
2½	200	100
3	300	200
4	400	300
4	500	400
*Gas Logs and Ranges.**		
½	100	1
¾	100	2 †
1	100	4
1¼	100	7

* One burner delivering 6 cubic feet per hour.

† The numbers for gas logs and ranges in the third column of the table refer to sizes for which the consumption in any log or range does not exceed 35 cubic feet per hour. The sizes of piping for these are for single lines run from or near the meter or source of supply for the specific purpose indicated. When gas logs and ranges are supplied by branch-pipes, or when any branch-pipes are run from the main system of the building, the combined sectional areas of all the pipe sections must exceed the sectional area of the main supply-pipe sufficiently to maintain the proper flow.

General Requirements.

1.—All lines of piping throughout the building, except drops, must be laid with grade so as to drip or drain back into the risers, with no depressions to hold condensation. Drips with drip-pipes, where needed, must be provided at meters and at such other points as the plan of piping may render necessary.

2.—No riser must be less than ¾ inch in diameter in any case; and all risers must be covered up on inside partitions, so as to be thoroughly protected from freezing. Wherever risers or other pipes cannot be guarded in this manner, they shall be protected from frost by special and effective coverings.

3.—Wherever practicable, all piping shall be exposed; but piping that must be concealed shall first be thoroughly inspected by the gas company, and the gas-fitter shall give due notice when the piping is ready for inspection. Unexposed piping must be so concealed as to be readily accessible in case of examination or repairs. Wherever practicable, as in floors, the concealment shall be made by boards over the pipes, secured by brass or other non-corrodible screws.

4.—In cases where extensions are made, care must be taken to extend with such sizes that the rules always prescribed shall be maintained.

5.—All drop pipes must be left perfectly plumb, and well secured in that position.

6.—Long runs of piping must be firmly supported at frequent intervals, so that no sagging or depressions can occur in which condensation can collect.

7.—If pipes run across wooden beams or joists, the requisite cutting, notching, or boring shall never be more than 2 inches in depth nor more than 3 feet from the bearings, and as near the latter as possible.

8.—Lines of piping shall not be placed under tiled or parquet floors, marble or other stone or metal platforms, or under hearthstones, unless the local conditions render such procedures imperatively necessary.

9.—All pipes shall be of the best quality of wrought-iron welded gas-pipe, and all fittings, including couplings, elbows, bends, tees, crosses, reducers, &c., under 2 inches in diameter, shall be extra heavy malleable fittings; those of larger diameter may be of cast iron. These pipes and fittings may be plain, galvanized, or made non-corrodible by any effective method.

10.—Pipes and fittings are to be put together with screw joints and red lead, or read and white lead mixed, with joints made perfectly gas-tight.

11.—All pipes shall be firmly and safely secured in position with hooks, wrought-iron straps, or holdfasts, secured with screws, at close intervals, so that continued use in proper line and grade may be effectively secured.

12.—Meters shall be placed where they will be most conveniently accessible for reading the index, and for examination and repairs. When placed on the walls, the minimum height above the floors shall be 2 feet for the bottom of the smallest meters, and the maximum height 8 feet for the top of the largest meters. The sizes of connections shall be as follows:—

3 light,	¾	inch	diameter.	60 light,	2	inch	diameter.
5	”	¾	” ”	100	”	2	” ”
10	”	1	” ”	150	”	2½	” ”
20	”	1¼	” ”	200	”	2½	” ”
30	”	1½	” ”	250	”	3	” ”
45	”	1½	” ”	300	”	4	” ”

13.—The completed piping shall be tested by some competent authority, who shall give a written certificate of the results before any of it is covered at any point. All outlets shall be tightly capped, and the whole system shall be tested preferably with a mercury gauge, or by a low-pressure spring gauge which has been recently and authoritatively tested by a mercury column. When air is pumped into a completed system of pipes until the pressure reaches 12 inches of mercury, and stands or remains stationary for five minutes, or if the column of mercury does not fall more than 1 inch per hour, the system may be considered satisfactorily tight; otherwise leaks must be sought and stopped, and the testing repeated until the preceding requirements are satisfied. When extensions to completed systems are made, the same tests shall be applied to the extensions before they are put in use. In the case of large buildings, the entire system may be tested in suitable sections.

The Pollution of the Thames.—The Thames Conservators are, we learn, considering the provisions of the Act they obtained last session, in so far as they affect the subject of the pollution of the river. By that statute, it may be remembered, the area under the jurisdiction of the Conservators with respect to pollution is increased from 1743 to about 3800 square miles, for which an additional income of £7500 per annum is to be provided. Of this amount, £1000 is to be carried to the Lower, and £6500 to the Upper Navigation Fund. The Conservators are endeavouring to devise means whereby an efficient examination of the whole valley of the Thames can be maintained, so as to prevent any contamination of the upper waters.

Separate Service-Pipes for Dwelling-Houses.—At the Epsom Petty Sessions, on the 8th inst., the Sutton Water-Works Company were summoned, on the information of Walter James Wing, for neglecting and refusing to furnish a supply of water to a number of dwelling-houses in Sydney Road, Sutton. Mr. Gordon, for the plaintiff, said the action was brought to decide whether the Company had rendered themselves liable to the penalties named in section 43 of the Water-Works Clauses Act, 1847. When Mr. Wing purchased the property in question, the service-pipes were laid. The Company had supplied water by means of these for years; but on Aug. 7, they served Mr. Wing with a notice, requiring him, within 42 days, to lay a separate pipe from their main to each house. Mr. Wing found himself under no obligation to lay down these extra pipes, and declined to do so, whereupon the supply was cut off, and had since been refused. He submitted that the Company having supplied the houses for a number of years could not now say the owner should lay separate pipes to each of the houses, when there was no legislative sanction for such a requirement. Mr. Fookes, on behalf of the Company, pointed out that by the Act of Parliament the Company could make any reasonable regulations from time to time; and it was therefore out of place for his friend to say that because his client bought these premises with the fittings in a certain form, they were to remain in the same condition for all time. In requesting that separate service-pipes should be laid, the Company were strictly within their rights. He submitted that the regulations were reasonable, and that the Company had taken the proper steps to enforce them. The Magistrates decided in favour of the Company; but they expressed the opinion that the Company had acted illegally in cutting off the water supply from half-a-dozen houses which already had a separate service-pipe. On the application of Mr. Gordon, their Worships agreed to state a case.

LEICESTER CORPORATION WATER SUPPLY.

The Deficient Rainfall and the Capacity of the Water-Works.

The attention which has lately been directed to the water supply of Leicester, owing to the great inconvenience caused to the inhabitants of the town by the compulsory curtailment of the service, will render specially interesting the following particulars as to the works, extracted from an article in a recent number of *Engineering*, prepared from statistics furnished by the Water Engineer to the Corporation (Mr. F. Griffiths, M.Inst.C.E.). As our contemporary remarks, the circumstances which have led up to the serious state of affairs now existing at Leicester are well worth careful study by all who are charged with the duty of maintaining the water supply of a community.

Commencing with the collection and the storeage of the water, the gathering-grounds and the reservoirs must be noticed first. Of the latter there are two complete—the Thornton and the Bradgate—and a third, called the Swithland, is in course of construction. All three are of the ordinary type of impounding reservoirs, with an embankment across the valley, and filter-beds and pure-water tanks adjoining. The Thornton water was laid on to the town in 1854, when the population was 61,000; the works being designed for the Water Company, in whose hands the supply then was, by the late Mr. T. Hawksley. The reservoir is about ten miles to the north-west of the borough; and the water-level is 404 feet above Ordnance datum. The gathering-ground of the valley extends to 2860 acres, a large part of which is agricultural land; the sub-strata being slate, rock, and marls, while in the watershed is the Barnhill granite. The highest point of the area rises to about 650 feet above Ordnance datum. The Thornton reservoir, when full, holds 333 million gallons; the water area being about 70 acres. It was completed in the year 1854 on the assumption that it would yield 1½ million gallons per diem, and would therefore hold a supply equal to 222 days. It is not yet called upon to yield this quantity; but the reservoir has only been twice full for short periods since 1889. The cause is deficient rainfall, inadequate collecting area, or a larger percentage of the rainfall evaporating and percolating than is usually accepted as general. The Bradgate reservoir is on the other side of the watershed; the two being divided by a tableland. It is at an elevation of 262 feet above Ordnance datum, which is not sufficient for the supply of the high-level parts of the town; and thus the water from it is pumped to the Gilroes service reservoir, the capacity of which is 2 million gallons, whence it gravitates to the town. There is another service reservoir at Oadby, also of 2 million gallons capacity. The surface formation and the sub-strata at Bradgate are practically the same as at Thornton; and here it may be added that the gathering-ground forms part of the site of the old Charnwood Forest, and brackens, ferns, &c., retain much of the water for subsequent evaporation. The Bradgate reservoir was constructed in 1866, also by Mr. Hawksley, and completed in 1870—eight years before the Corporation took over the water supply. The reservoir, covering about 120 acres, has a storeage capacity of 556 million gallons; the area of the gathering-ground being 4400 acres. The yield was assumed at 2½ million gallons; and the storeage capacity as equal to 222 days' supply, as in the case of the other reservoir. The total area of gathering-ground is therefore 7260 acres; the reservoir capacity, 889 million gallons; and the yield, 4 million gallons.

We now come to the means of supplying these reservoirs—viz., the rainfall. Dr. Dalton, the eminent meteorologist, estimated that, taking the whole of England, about one-third of the rainfall found its way into the sea. This is considered to be correct as regards the Thames; but in mountainous districts, the proportion of the rainfall flowing down the streams is greater—being often one-half or two-thirds, and sometimes more. The Leicester area cannot be described as mountainous; and the works were laid out on the assumption that there were 24 inches of rainfall in the year, of which 8 inches would be collected in the first reservoir. An inch of rainfall over the entire area gives 164 million gallons, two-thirds of which—about 110 million gallons—being evaporated, or percolating into the soil, leaves but 55 million gallons; so that 2 inches per month on this area might be sufficient, on the most favourable assumption, to maintain the supply of 3·6 million gallons of water per day. The actual quantity consumed has never exceeded 4 million gallons per day. The normal daily supply is, however, in round figures, 3½ millions. On an average of 15 years, the rainfall has been 26·6 and 27·7 inches per annum at Thornton and Bradgate respectively; while the average since the beginning of 1892 has been 1·79 inches per month at Thornton, and 1·84 inches at Bradgate.* Now, had one-third of this passed into the reservoirs, it is certain that the stock would have remained constant; for the quantity thus yielded would have been equal to the actual delivery. But, as a matter of fact, the reservoirs were full in March, 1892—having 889 million gallons; and now they have only about 103 million gallons. Instead, therefore, of 100 million gallons being yielded by the true average of 1·825 inches per month over the whole area of 7260 acres, the actual yield was 72 millions. In other words, the net decrease in the stock was 776 million gallons, and the supply was for the 33 months about 3137 million gallons; so that the amount collected from the rainfall was 2360 million instead of 9900 million gallons—the ratio being therefore about one-fourth, or 24 per cent., of the rainfall, and not one-third.

This point, of course, was established formerly by actual tests; for Mr. Griffiths, seven or eight years ago, when the need for new works was being discussed, made careful measurements, and found that at Bradgate, in 1887, when the rainfall was 19·08 inches, the actual amount passed into the reservoir, according to gauge, was 3·80 inches

* The ordinary assumption is that the wettest year will have had a rainfall nearly half as much again as the mean; here it is in one case 35·02 in. against 26·6 in., and in the other 37·23 in. against 27·7 in. The driest year should have one-third less than the mean. In the one case here it is 19·33 in., in the other 19·08 in., so that the ordinary assumption is not supported; but the average three driest years now concluding, 21·48 in. and 22·08 in. respectively, is about right—a fifth less than the mean. According to the past practice, the rain recovery from the drainage area should be based on this mean of three dry years.

—showing an evaporation and absorption of 15·28 inches. Here, therefore, the proportion utilized is about one-fifth. That was a year of very low rainfall. In 1886, a year of plenty, the amount gauged into the reservoir was 6·93 inches out of the total fall of 31·73 inches; the evaporation and absorption being 24·80 inches. In this case, 21·8 per cent. was collected.

A point which in large measure explains the reason why the evaporation and absorption is three-fourths or four-fifths, is the small quantity of rain which falls at a time, and the large number of days without any rain, which results in the ground being prepared for absorption. It may be taken that comparatively little rain is recovered with a fall of less than ¼ inch in the 24 hours; so that the number of days yielding more than this quantity is important. In 1891, which was a satisfactory year, there being 30·42 inches at Thornton and 32·74 inches at Bradgate (the latter, peculiarly enough, has usually the greater fall), there were eight days with more than ¼ inch at Bradgate and eleven at Thornton; while in subsequent years the number has steadily decreased —there being only four and three respectively last year. The dry days seem just now to average about eighteen per month; so that for every two wet days there are at least three dry days, and when so few of the former yield more than ¼ inch, it is easy to understand the low percentage of yield to the reservoirs from the rainfall.

But even in 1891—a good year —there were, on an average, sixteen dry days in the month; and generally it may be taken that instead of 24 inches being quite a satisfactory annual rainfall for the area, it should be from 32 to 35 inches to yield the 4 million gallons a day regularly; otherwise the collecting area would have to be greater. In 1892, the number of days on which no rain fell at Thornton was 217; and when more than ¼ inch fell, 9—the figures for 1893 and 1894 being 220 and 6, and 145 and 3. The figures for Bradgate for the above named years are: 188 and 4, 210 and 4, and 129 and 3.

Some indication from other sources may be given of the effect of very limited rainfalls, especially as they reflect on the general question of the ratio of available to total rainfall. When the water fails to penetrate beyond a depth of 3 feet from the surface-level, it is lost, as it never gets beyond the power of the sun to evaporate; and in summer this is specially pronounced. It has been shown that, over a series of 30 years, the average rainfall at Nash Mills, Hemel Hempstead, in the Thames Valley, was 27·843 in., of which 6·519 in. alone penetrated through the 3 feet from the surface. Even in chalk the percolation was but 10·65 in.; but in the Leicester district, there is over the gathering-ground a deep overlayer of soil. In summer, the rainfall at Nash Mills was 14·091 in., of which only 0·821 in. percolated; while in winter 5·707 in. percolated out of 13·752 in. of rainfall. But the average, as already shown, is but a fourth; and the fact that the day's rainfall at Leicester is seldom over ¼ inch would give ground for the assumption that even a fourth, as the proportion of available to total rainfall, is very liberal. Cases of three successive dry years in the Thames Valley again showed that, out of an annual average of 22 in., only 3½ in. percolated, and 4 in. out of 25 in.

As to the average rainfall at Leicester, it has seldom exceeded 30 in.: and only three times has the stock reached the full storeage capacity since 1889. First, early in 1890, as a result, probably, of the heavy rainfall in the autumn, and October, December, and January. The last three months together yielded fully 8 in., while at that time the consumption was about 3½ million gallons per day; so that the rainfall gave, even on the assumption of only a fourth being available, considerably more than was required. In fact, to be satisfactory, the mean rainfall should now be not much below 425 million gallons per month, if the consumption is near 4 million gallons per day. The filling up of the reservoir about the beginning of 1892 is due to the rainfall being so considerably above this. On the other hand, for two years the rainfall has only once been up to this point; and hence the scarcity of water. The remedy is therefore really an increase in the gathering-ground.

Notwithstanding the growth in population, the annual increase on which is about 4 per cent., the consumption of water has decreased. In September, 1893, for the first time the supply ceased to be constant, the number of hours to which it was at first reduced being 16 per day. Now the supply is for 11 hours per day; the consumption per head being 12·20 gallons. The ordinary supply is probably nearly 20 gallons per head, which, in view of the use for manufacturing purposes as indicated by the meter supply, is very satisfactory, especially when one recalls that the consumption in many other districts is double that proportion. This result is in great part due to the means adopted by Mr. Griffiths, in which the waste-water meter plays no part—night inspection and stethoscoping being the system used.

It is long since the authorities of Leicester recognized the need for an additional source of supply. The works were taken over by the Corporation in 1878; and almost since that time additional gathering-ground has been sought after. Arrangements were made to test the quality and quantity of the underground water at the Lindridge Colliery; and in 1884, further trials were made at the Snarestone Colliery. These sources were abandoned, as the water, on analysis, proved to be unsuitable, especially for manufacturing purposes. Subsequently the Corporation applied to Parliament for power to construct an additional reservoir at Black Brook. The town of Loughborough, however, opposed the scheme, and succeeded. Leicester proposed to construct an impounding reservoir of 600 million gallons capacity, as Loughborough is simply taking the high-water flow of the stream. Having lost this scheme, Leicester, on the advice of Mr. Hawksley, decided to construct an impounding reservoir at Swithland, an extension of the same drainage area as that of the other two reservoirs. This scheme was approved by Parliament in 1890. The area is 8 miles north of Leicester. Even here opposition was experienced by the people of the villages of Quorn and Barrow; and, by agreement, Leicester had to construct works within twelve months for the supply of these districts. In the meantime, negotiations were entered into for the acquisition of land from Lord Lanesborough. The proceedings were unfortunately prolonged owing to the processes of arbitration; so that it was not until April of the present year that the contract was let to Messrs. Aird and Sons for £133,511, and the works are now being proceeded with. The lands, extending to 275 acres, cost £42,987, including compensation.

The detailed plans for the reservoir have been prepared by Mr. J. B. Everard. The new works consist in the construction of a reservoir, by the erection of a dam about 1600 feet long across the valley at Buddonwood, the construction of filter-beds, and of a pumping-station to raise the water to a new service reservoir at Hallgates, at a sufficient elevation to enable water to gravitate to all parts of the town. The Swithland reservoir, the water area of which is 200 acres, is designed to store 530 million gallons, which will make the total of the three reservoirs 1419 million gallons—amply sufficient for the population at 20 gallons per head per day. But, as already shown, the difficulty is the insufficiency of rainfall. Should the average fall over the 3500 acres of gathering-ground at Swithland be equal to 24 in., yielding 6 in. in useful storeage, the supply per day will be 1⅛ million gallons. To get 2 millions would require a rainfall of 36 in., and experience does not indicate this to be probable. But 1⅛ millions will suffice to serve 65,000 more than the existing population, which is 206,000. The total drainage area is increased to 10,760 acres. An inch of rainfall on this equals about 669,000 gallons per day per annum; but, as only one-fourth of the rainfall can be depended upon as serviceable supply, the gross annual rainfall of 24 in. would give about 4 million gallons, which, at 20 gallons per head per day, is sufficient for a population of 200,000. With a gross rainfall of 32 in. per annum, the supply might be 5⅓ million gallons, equal to 20 gallons per head for a population of 270,000. It is for the Corporation to determine whether even the Swithland works, when completed, will obviate a recurrence of the existing serious state of affairs.

But the Swithland reservoir will not be completed for two years, so that in the meantime temporary sources of supply have to be found. In October, 1893, the Water Committee, acting on the suggestion of their Engineer, arranged first with the Ellistown Colliery Company for a supply of water; and about 340,000 gallons per day are, we believe, obtained from this source. This water is pumped from a shaft above the coal measures. The coal working is about 300 feet below the surface level, and the water area is 100 feet. The substratum is red sandstone, with a layer of whinstone, which retains the water. This water is conveyed 2 miles through a 10-inch pipe to the Thornton reservoir; and the supply was started in December, 1893. Again, it was found, when sinking trial shafts in the Swithland Valley, that there was a large yield of water; and pumps were installed to take the surplus water from these shafts and the stream, and send them back up the watershed to the Bradgate reservoir. The capacity of the pumps is equal to a million gallons per day; but the supply is about half a million. Even this quantity has been reduced lately, owing to the drought; so that there has been a continued depletion of stock. The next move was the utilization of three or four wells used by manufacturers for the supply of water principally for condensing purposes; while two or three new wells are being sunk by the Water Committee.

The Position of the Supply.

In a statement published on Wednesday last, Alderman Wood, the Chairman of the Water Committee, thus summed up the position with regard to the water supply of Leicester: "We anticipate 600,000 gallons a day well water from the town, 500,000 gallons a day from Newtown Unthank, and 740,000 gallons a day from Swithland and Ellistown; bringing the auxiliary supplies up to 1,840,000 gallons, against a consumption of 2,500,000 gallons. This is practically independent of any rainfall; but we are going on with further explorations. I have the authority of my Committee to act in this matter in conjunction with Mr. Everard as we judge to be the best. We intend getting whatever water is available; and I hope to find another 500,000 gallons a day. That will give us a supply almost equal to our present consumption, independent of any rainfall whenever—except that it may be diminished by frost. . . . As to the future, the daily consumption is, as I have said, 2,500,000 gallons. We shall be putting into the mains by the end of the week, 1,200,000 gallons from auxiliary sources; leaving us to draw from the reserve stock 1,300,000 gallons. We estimate our reserve stock at 50 million gallons, leaving 44 millions in the reservoirs. Two weeks' consumption at 1,300,000 gallons a day will mean 18,000,000 gallons. That will bring us to Oct. 27, and leave us at that date with 32,000,000 gallons in stock. By that date we hope to increase our auxiliary supplies by 200,000 gallons a day, by the extra water from Messrs. Pickard's and the Bedehouse Meadows. That will reduce the demand on the reserve stock to 1,100,000 gallons a day, and at that rate the stock will be further reduced by Nov. 17 by 23 million gallons, leaving us only 9 million gallons in stock. On that day, however, we anticipate being able to add the 500,000 gallons a day from Newtown Unthank; leaving our demand upon the reserve stock from that date at 600,000 gallons a day. It would then last to the 1st of December before we have consumed all our reserve stock; and at that time we shall have nearly 2 million gallons a day inflow from auxiliary sources. Those are the calculations made by Mr. Everard, Mr. Griffith, and myself."

THE NEW WATER SUPPLY OF LIVERPOOL.

At the Meeting of the Liverpool Literary and Philosophical Society yesterday week, Mr. J. Parry, M.Inst.C.E., the Water Engineer of the Liverpool Corporation, read a paper entitled "The New Water Supply of Liverpool."

After dealing with the early history of the place and the various surveys made of the River Vyrnwy and its surroundings on behalf of the Metropolis and Liverpool, the project of the latter being ultimately adopted, Mr. Parry said: In selecting a river as a source of supply for a large community like that of Liverpool, the first question to be considered was whether the watershed, or gathering-ground, from which the water was to be collected was of such a character as to yield, and to continue to yield, water of a quality suitable for domestic and trade purposes. Freedom from danger of pollution by sewage was, of course, of the very first importance; but this was not the only danger

to guard against. There were such things as mining operations, extensive peat bogs, and other contaminating influences which might make a watershed unfit, or at least unsafe, as a source of water supply. An ideal gathering-ground would consist of uninhabited granite rocks, without any covering of soil or vegetation. Assuming the quality of the water to be satisfactory, the question arose as to the quantity being sufficient for the needs of the district to be supplied, not only for immediate requirements, but also for a reasonable number of years in the future. Mention having been made of other necessary requirements, Mr. Parry proceeded to remark that in the Llanwddyn Valley, all the conditions which he had described were very fairly and fully satisfied. The area from which the water was gathered lay on the eastern slope of the Berwyn Hills, which there rose to an elevation of 2000 feet above the sea-level. As a site for the construction of a reservoir, the valley possessed advantages of quite an exceptional character. It had been conclusively shown that in ancient times there existed on the same spot a lake formed by glacial action; traces of ice movement being distinctly found on the rocks.

When the Corporation applied to Parliament for power to carry out the scheme, strong opposition was offered by persons interested in the rivers; the opponents extending right away from Llanwddyn to the Bristol Channel. Some of them were satisfied with money compensation; but the chief consideration agreed upon or imposed was that the Corporation should deliver out of the new reservoir certain compensating waters, amounting altogether to 13½ million gallons per day, to be sent for all time down the old river course. The compensation water was about seven times the amount of the dry river flow. The Vyrnwy reservoir or lake consisted of the valley as formed by Nature, with the lower end blocked by a dam. At the site of the old village of Llanwddyn, the valley was more than half a mile in width; but about two miles lower down, the valley became a narrow ravine, on the steep sides of which the rock crops out at the surface. Across this narrow neck, a masonry wall has been built to a height of 84 feet above the river bed, the effect of which was to hold back the water and make a lake nearly five miles long. The length of the wall at the top is 390 yards; and the contents of the lake when full is between 12,000 and 13,000 million gallons.

Mr. Parry then entered into some lengthy details connected with the construction of the aqueduct, the arrangement of the pipes running from Lake Vyrnwy, the filter-beds, and other minor matters; and he afterwards gave an interesting description of the route of the lines of pipes. It was obvious, he remarked, that to reach Liverpool from any part of North Wales, the Mersey must be crossed somewhere and somehow. In laying out the Vyrnwy scheme, the method of crossing the river was necessarily an important factor. The position ultimately selected was chosen because of the facility with which pipes could be placed in the bed of the river; the intention being that a trench or channel to contain the pipes should be formed by dredging or by hydraulic jets in the sand. Unfortunately, and most unmistakenly, as he believed, this plan was opposed by persons interested in the navigation above Runcorn, and chiefly by Warrington; and the House of Commons put a clause in the Bill according to which the depth of the aqueduct under the river was to be fixed by the Board of Trade. In due course, the Board of Trade held their inquiry, and fixed the depth at such a level in relation to the river bed as to make the construction of a tunnel inevitable. Elaborate boring proved the existence of a sandstone rock at the depth of 60 or 70 feet under the middle of the river, and overlying a bed of rock and bed of boulder clay varying in thickness. Designs were prepared for a tunnel to be made through this bed of clay; but the contractors abandoned the undertaking after completing one shaft and about 50 feet of tunnel. New contractors undertook the task; and they failed to carry out the whole of their contract, which had to be completed as day work. The tunnel was lined with cast-iron segments, built in position as the work advanced. As a matter of scientific interest, the contract was important, because it afforded an example of successful tunnelling through an ever-varying mixture of sand, gravel, and shingle, full of water, with a big tidal river overhead.

A vote of thanks was accorded to Mr. Parry at the close of the paper.

WATER FILTRATION IN THE UNITED STATES.

At the recent Meeting of the American Water-Works Association at Minneapolis, a paper on the above subject was read by Mr. J. B. Rider, of New York, in the course of which he made the following remarks:—

It is not the object of this paper to discuss the merits and demerits of any of the filters on the market. While several failures have occurred, many of the filters are doing good work; and each year shows a marked advance in the elimination of disease-producing germs. After a partial failure in Berlin and other places, to America belongs the credit of having demonstrated that, by proper filtration through sand, without the aid of chemicals, typhoid fever and other disease-producing germs can all be eliminated from drinking water at a reasonable cost.

Filter-beds in America seem to have few friends and many enemies; but, after considerable experience with them, I am forced to believe that they not only have merit, but are deserving of as much consideration as any one of the pressure or gravity filters. In many cases a plain dyke of sand and gravel has answered the purpose. At Waterville (N.Y.), with a population of 1500, the water at times is highly charged with vegetable matter and much clay in suspension. After passing through a dyke, the water is made perfectly clear and wholesome; and never, to the best of my knowledge, has any fault been found with it. The dyke cost $1500, and has been in continuous operation since 1888. The cost to clean it has been about $20 a year, which, added to the interest on the investment, would make the total cost $80 a year, or 5½ c. per head.

At Bethel (Conn.), with a population of 2500, the water was highly contaminated with vegetable and animal matter. Its odour was very offensive—in fact, the supply was so bad that it could not be used for drinking purposes, or in the manufacture of hats, which is the largest industry at Bethel. Something had to be done; but, bearing in mind the injurious effects of alum on fine colours, it was decided to employ some method which would not involve the use of chemicals. Accordingly, there was designed for them a simple filter, properly underdrained, with a submerged well in one corner. The gates were so arranged that water could be drawn down to the bottom of the filter-bed, and the air allowed to circulate through it. Thus one filter-bed was made to possess all the advantages of intermittent filtration; and, in addition to the benefits of nitrification thus gained, the action of the sun in drying up the sediment on top of the bed saved much work in scraping the surface, for after a few hours' exposure the sediment peeled up and dried, and floated ashore upon refilling the bed with water. It was calculated to, and does, filter 300,000 gallons a day at the rate of 5 gallons per square foot per hour, or 5,227,200 gallons per acre per day. The total outlay for the improvements, including a long dam for increased storeage capacity, was about $6000; but only $300 can be charged as the cost for the filter. The expense of operating, including the removal of the sand, is $50 per annum, which, added to the interest on the investment, makes $170 a year, or 6·8 c. per head. Analysis shows that upwards of 94 per cent. of the organic matter is removed by filtration. The lowest estimate we had for a filter using alum was $3200 for the first cost, and the running expenses estimated at $1·85 per diem, of which 60 c. was for alum and $1·25 was for attendant. It will be seen that this, added to the interest on the investment, would have made a total of $803·25 per annum; therefore Bethel has saved each year since 1890 $633·25, or more than 25 per cent. per capita per annum, in using the filter-bed instead of the cheapest mechanical filter offered.

At Nantucket (Mass.), in 1892, a filter-bed similar in principle to that of Bethel, with minor conditions, was constructed. The water supply here is taken from a pond with no visible inlet or outlet, and the water seems to percolate into it from the sandy territory surrounding it. About every alternate year, they are troubled with vegetable growth for about three months, generally in August, September, and October. The result of the filtration of the water was, first, that 68 per cent. of the organic matter was removed; that 13 out of 16 genera present were filtered out; that crenothrix and anabæna spores were absent in the filtered water; while out of a total of 216,000 anabæna per 100 cubic centimetres, but 3600 remained, or 98⅓ per cent. were removed. The iron was reduced to the extent of 11-12ths; but this is probably because the organisms removed contained much iron, though aëration no doubt had considerable effect. An average of 96 per cent. of the micro-organisms were removed during the season of three months; the average amount of organic matter removed, as represented by the albuminoid ammonia, being 65 per cent. One strange thing at Nantucket was that occasionally an odour could be detected in the filtered water. It was observed, however, that, as the aëration was increased and the temperature reduced, it became much fainter. It is the intention to carry out the original plans to the letter this season, and first to construct a submerged well, so that the filtered water can be protected from heat and light; secondly, to cover the stand-pipe so that it will be light-proof; and, thirdly, to take the air from an adjacent ice-house, instead of from the hot engine-room as at present. The total expense of the plant was $4500; and it cost $90 per annum to operate. The sand used would pass 40 million gallons a day through 12 inches under a 12-inch head.

At Lawrence (Mass.), a filter-bed 2½ acres in area is in successful operation. In its projection, the Engineer has shown a great deal of ingenuity and considerable study. It is designed to filter at the rate of 2 million gallons per acre per diem. The finest sand used will allow 50 million gallons per acre to pass through 12 inches of it, under a 12-inch head. It has successfully removed, when working at the above rate, 98·33 per cent. of all bacteria; and though it has been in operation only since Sept. 20, 1893, the marked decrease in deaths from typhoid fever from a total of 43 for eight months in past years to 17 for the present, shows how nearly perfectly the filter must operate, especially when it has been shown that 9 out of the 17 persons who died had frequently drunk of the unfiltered water. The death-rate from typhoid fever was in reality, therefore, reduced nearly 82 per cent.; while the organic matter, as represented by the albuminoid ammonia, of which 15 or 20 per cent. is in suspension, was lowered 45 per cent. It cost about $75,000; but had other than home labour, at $2 per day, been employed in its construction, its cost would not have exceeded $50,000. The total cost for maintenance, as estimated by the Superintendent (Mr. Salsbury), is as follows: Interest on $75,000, at 4 per cent., $3000; cost for cleaning filter-bed and replacing sand, $3000—total, $6000, or 12 c. per capita per annum. The Superintendent states that, to provide for a 7-million gallon mechanical filtration plant, a filter company wanted about $60,000; but assuming they could get one at the low price of a 5-million gallon plant for $30,000, the interest on this sum would be $1200 per annum, which, added to the cost for coagulant and attention, to say nothing of the water necessary for cleansing, would certainly make the cost for running a mechanical filter plant at Lawrence as much as it now costs the city.

One thing is certain, that to-day many filter-beds in America are giving far better results than the old ones of Europe; also that a filter-bed properly cared for, as at Lawrence, Nantucket, Bethel, and other places, ceases to act entirely as a strainer, but by the admission of air by the drawing down of the water to beneath the bed, chemical action takes place. Recent investigation has proved beyond question that, where a bed is not forced to filter beyond more than (say) 8 to 10 million gallons per acre per diem, most micro-organisms are retained in the upper portion of the bed, and do not pass down into it. It has been demonstrated that the cost of cleansing is not great, and that the expense of construction under favourable conditions is not greater than that of a mechanical plant, and frequently less. In short, all that has been said against filter-beds and mechanical filters is not true. Both have done good, and often indifferent work; but to-day there is no excuse for having a poor filtrate from either. The great efficiency of filter-beds and mechanical filters has been so thoroughly demonstrated by experience that there is no excuse for any community to use unfiltered water. About all there is in this life for a man is contentment. Without health, this is impossible; and no community can be healthy while drinking bad water.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

Last Monday, the Works Committees of the Dundee Gas and Water Commissions were called together, to consider a proposal to apply to Parliament next session for further borrowing powers. As to the Water Commission, it was explained that it was intended to acquire land for the construction of filters. The Gas Commission, it was stated, had exceeded their borrowing powers by £13,000, which had been caused by increases to capital account by additions to works and the like. Lord Provost Low thought they had better wait for another year. There was no immediate need for hurry; and as their Corporation Act had just been passed, it might be discovered, after it had been worked some time, that it would require amendment. He thought, therefore, that they should wait for another year before applying to Parliament. This proposal met the views of the Committee; and consequently nothing will be done in the meantime in the matter.

The Falkirk gas arbitration is now to proceed; but the date of the hearing has not yet been fixed. This much was told by Mr. Storey, the Convener of the Lighting Committee of the Corporation, at a meeting of the Town Council last week. In reply to a question, he said that the matters which had been before the Court had been withdrawn, and that there was every hope that they would soon go on with the arbitration. He was also pleased to say that the Gas Company had stated a price. Mr. Gardiner, Sheriff-Clerk, has been appointed clerk in the arbitration. The streets have been opened in various places, to allow of the pipes being examined by Mr. Linton, of Leith, and Mr. Stevenson, of Manchester, who are to be witnesses for the Corporation. At meetings of electors in connection with the municipal elections, councillors are warding off questions as to the transfer on the plea that, while negotiations are pending with the Company, it would be injudicious to make public what is being done.

Referring to my note of last week regarding the progress of the Peebles oil-gas process, I may say that I casually met the patentees this week, and learn from them that the process has recently been introduced into the gas-works at Barrhead and Thornliebank, in Renfrewshire, and at Tillicoultry, in Clackmannanshire; and that it is being installed at Pernambuco, in Brazil.

A complaint of an extraordinary nature was made by one of the Lockerbie Police Commissioners at the close of the Gas Commission meeting last week. The speaker, Mr. A. Jardine, was incensed because he had been refused admission to the gas-works by the wife of the Gas Manager. One member suggested that no one was refused admission who went civilly; and this remark had the effect of rousing still further Mr. Jardine's ire. There was also a suggestion that no one should go prying about the office, turning up papers and the like. This led to Mr. Jardine throwing out a challenge for proof; but it was pointed out to him that no name was given. Ultimately it was resolved to call the Gas Manager before the Commission to give an explanation. It is not often that such an incident is heard of as the exclusion of a Gas Commissioner or Director from his own works. I suppose it will be generally conceded that a gas manager has not the power to do so. It is possible that a manager might have a grudge against a particular Commissioner; and it must be the case that some Commissioners are disagreeable visitors. But that is a state of matters which the manager must just endure, if he cannot remedy it by some other method than exclusion.

The strange thing happened this week at the village of Comrie, in Perthshire, of three men being nearly suffocated by gas in a police cell. When the cell door was opened on Monday morning, the three men were found to be in an unconscious condition. Two of them lay in a critical state for several hours; but all three have recovered. It has not yet been divulged how it came to be that gas was admitted to the cell; but, of course, it was something connected with the lighting appliance. As this is usually placed in prison cells at a height which prevents the prisoners from interfering with it, it would appear not to have been the work of the unfortunate inmates. It is not likely that the men were aware of their peril; but if they had been, it would be melancholy to think of their being exposed to such a danger, without the ability to escape from it.

Provost Wylie, of Hamilton, addressing the electors of the burgh on Thursday night, gave an account of the good work done in connection with the gas undertaking; and he went on to say that he had been told by a person who had lighted his shop by electricity, in a place where the price of gas is 3s. 9d. per 1000 cubic feet, that electric light at 5d. per unit is 40 per cent. dearer than gas. If that were the case, where gas cost 2s. 1d., electric lighting would be from 50 to 60 per cent. dearer. He did not believe that electric lighting would be a paying concern in Hamilton. I should think not, while gas remains at so low a price. The testimony of the person whose case he cited is valuable, being founded on experience, which it is difficult to get at.

The strike of Scotch miners is now at an end. It was so in the West last week; but the men in the Lothians and Fifeshire held out. On Wednesday, the Lothians men gave in, and resolved to seek work from their old employers. To-day it is announced that the Fifeshire men have also come to the same resolution. The men have been thoroughly beaten all along the line. They have been out for 17 weeks, the same time as the strike lasted in England last year; and it is calculated that in that time they have lost a million and a quarter sterling in wages. The contributions from the Federation in England amounted to about £75,000. Adding other contributions and local union funds, it is estimated that about £100,000 was distributed among the men on strike while they were out.

Professor Kennedy, the Consulting Electrical Engineer to the Aberdeen Corporation, has presented a report to the Town Council on the subject of increasing the capacity of the electric lighting plant. He says he allowed two years in which the existing plant might suffice; but it is very satisfactory to find that, although the installation has only been running for six months, its full capacity of 7000 lamps of 8-candle power is nearly reached. He suggests the addition of plant and mains to increase the capacity of the installation to 15,000 lamps, at a cost of £4350, which will make the total expenditure on the installation £29,000.

An addition to the water supply was inaugurated at Alloa on Tuesday. The new works have been constructed according to plans furnished by Messrs. Leslie and Reid, of Edinburgh. They include the heightening of the embankment of Gartmorn reservoir by three feet; the construction of a new circular reservoir, settling-ponds, waterhouse; and an engine for raising water for the high-service system. The cost has been over £30,000. It is expected that there is now sufficient water to meet the wants of the burgh for two or three generations. The water was turned on by Provost Thomson, in presence of the Police Commissioners; and the proceedings were wound up by a luncheon.

A settlement has been effected of the dispute between Mr. Robert Paterson, of Birthwood, Biggar, and the Airdrie and Coatbridge Water Company. The Company are constructing a reservoir upon the estate of Lamington, adjacent to Mr. Paterson's; and he complained that they were unwarrantably making use of his estate as an access to the reservoir. Three actions and a petition and complaint as to alleged breach of interdict have been brought by Mr. Paterson against the Company during the past two years. The Company have now purchased a servitude right of access to their reservoir along the margin of Mr. Paterson's estate; and all his proceedings against them have been withdrawn.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Oct.* 20.

Sulphate of Ammonia.—There is no material change, except that the downward tendency seems to be checked for the present. There has been a little more buying for near delivery; but the principal inquiry has been for future contracts, of which, however, none are available. Makers wisely refrain from selling beyond their immediate production, and thus strengthen the market—first, by not accumulating stocks; and, secondly, by forcing those who require supplies to secure them out of the present production. A few forward transactions are reported to have been concluded by speculators; but it is impossible at present to foresee the end of these ventures. As usual of late, there has been great irregularity in the quotations; and they have ranged between £11 17s. 6d. to £12 2s. 6d. But the higher quotation may be taken as nearer the proper value. It is a good sign in any case that nearly all parcels offering this week have found buyers, and there is not a large quantity left available. Nitrate is quiet and unchanged.

LONDON, *Oct.* 20.

Tar Products.—Benzols are dull; but makers are free from stocks, and the production during the ensuing season is likely to be considerably less than in former years, from various causes. The high value of pitch for prompt delivery continues; but important sales have been made during the week for forward delivery at 35s. Solvent naphtha moves off more freely; and its anomalous position in value, compared with benzols, continues. Creosote and other tar oils are languid; but the larger trade being done in naphthalene has materially reduced the bulk of ordinary creosote offering. Anthracene is firm at the Tar Products Committee's prices. Carbolic acid, though selling more freely, does not improve so far as crude is concerned; but 40 per cent. crystals are quoted a farthing higher. The following prices represent the business of the week: Tar, 16s. 6d. to 20s. Pitch, prompt, 38s. to 40s.; forward, 35s. Benzols, 90's and 50's, 1s. 2d. Solvent naphtha, 1s. 3d.; Toluol, 1s. 4d. Crude naphtha, 5½d. Creosote, liquid, 2¼d.; ordinary, 1¼d.; salts, 17s. 6d. Carbolic acid, 1s. 6d. Cresylic acid, refined, 1s.; brown, 9¼d. Anthracene, "A," 1s. 1d.; "B," 10½d.

Sulphate of Ammonia is undoubtedly stronger. There is now more inquiry; and important sales have been effected during the week at prices ranging from £12 2s. 6d. to £12 7s. 6d., less 3¼ per cent. A much better feeling exists; and the price is likely to improve. Gas liquor is quoted at 9s. to 10s. 6d.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—There is still no improvement in the coal trade of this district, except what the season of the year brings forward in the demand for the better qualities suitable for house-fire purposes. These are moving away more freely, with pits getting into more regular work—here and there on full time—and prices for the best qualities show a tendency to harden up to list rates. About 11s. to 11s. 6d. is now the average for best Wigan Arley; 10s. to 10s. 6d., for seconds Arley and Pemberton four-feet; with the lower qualities of house coal ranging from 8s. to 8s. 6d., at the pit mouth. With regard to other descriptions of fuel, the outlook continues very unsatisfactory. Common round coals meet with no better demand for iron making, steam, and general manufacturing purposes; and there is a prospect that, with the close of the shipping season for the Baltic ports, Yorkshire coal may be pushed in this district at still lower figures—one or two of the coalowners in the above district already putting forward inquiries as to the possibility of placing inland orders at under their present quoted rates. For Lancashire steam and forge coal, 7s. to 7s. 6d. remain about the average figures; but that they may be forced down to even a lower point than this, is certainly within the range of possibility. Engine classes of fuel become, if anything, still more of a drug upon the market, owing to the increased quantity of slack now being produced with the enlarged demand for house-fire qualities; and prices are very irregular in the open market. Slack from outside districts is offering here at very low figures. Derbyshire slack is readily obtainable at 1s. 6d. to 1s. 9d.; and Lancashire slack is to be bought at 3s. 6d. and 4s. for common, 4s. 6d. to 5s. for medium, and about 5s. 6d. for the best qualities at the pit mouth. For shipment, there is a moderate inquiry, with Lancashire steam coal averaging 8s. 6d. to 9s. per ton delivered at the Garston Docks, or the High Level, Liverpool.

Northern Coal Trade.—The demand for steam coal is rather less than it was, that for Scotland being now about brought down to its

normal extent. But as the exports continue on a large scale, there is still the taking up of a full production. Best Northumbrian steam coal is steady at about 10s. 9d. per ton f.o.b. for prompt shipment; whilst for delivery a little forward, when the exports may be less, a rather lower price is accepted. Second-class steam coal is quoted at about 10s. per ton; and steam smalls are quieter, and may now be had at about 4s. 6d. There is a fair demand for manufacturing coal locally; but the supply is abundant. In regard to gas coals, a few very small local contracts have been arranged, at prices that are from 7s. to 7s. 6d. per ton f.o.b., or equivalent rates; but some colliery owners who are well placed ask up to 8s. per ton. As there is now a large and increasing delivery of gas coals, most of the collieries are well employed. The price for odd cargoes does not materially differ from that just given for contracts, though it should advance as the pressure for supplies increases. There is still a good inquiry for smithy coal at fair prices. In regard to coke, the demand is rather variable; the exports being a little larger, whilst the home consumption is steady. Best Durham coke is quoted at 13s. 6d. to 14s. 6d. per ton f.o.b. in the Tyne or at West Hartlepool. Gas coke is now in larger supply; but so far it is well taken up, and the range of prices shows no alteration this week.

Scotch Coal Trade.—There is great activity now that the strike of the miners is over. As yet business is only of the prompt description; purchasers being in expectation that prices will come down further. The output is, of course, restricted in the meantime, on account of the state of disrepair into which underground roads and working places have fallen. Quotations are now available, but are not reliable for any length of time. Main is selling at 8s. 3d., ell at 9s. 3d. to 9s. 6d., splint at 7s. 6d., and steam at 9s. 9d. per ton, f.o.b., Glasgow. The last full quotations given in this report appeared in the JOURNAL for June 12, and were: Main, 7s. to 7s. 3d.; ell, 8s. 3d. to 8s. 6d.; splint, 7s. 9d.; and steam, 9s. to 9s. 3d. There has been a considerable improvement in shipping, particularly from western ports. The shipments amounted to 47,206 tons—an increase upon the quantity in the preceding week of 22,382 tons; but a decrease, when compared with the corresponding week of last year, of 192,803 tons. For the year to date, the total shipments have been 3,866,263 tons—a decrease, as compared with the corresponding period of last year, of 2,215,639 tons.

The Joshua Horton's Patent Gas-Governor Company, Limited, has been registered with a capital of £2000, in £5 shares, to acquire and carry on the business of patent gas-governor manufacturers hitherto conducted by Mr. J. Horton at Birmingham.

Extensions of Gas Plant for the Midland Railway Company.—The Whessoe Foundry Company, Limited, have been entrusted by the Midland Railway Company with the carrying out of extensions of gas plant, consisting of two holders and cast-iron tanks, four condensers, and two scrubbers, with all the necessary valves and connections, for the Leicester Station.

Reduction in Price.—The Directors of the York United Gaslight Company last Thursday made a further reduction of 1d. per 1000 cubic feet in the price of gas, to take effect from the commencement of the current quarter. This reduction, added to that made in April last, will make a total of 2d. per 1000 cubic feet within the present year, leaving the scale of prices as follows: When the consumption for one year ending in June is under 500,000 cubic feet, the price for the following year will be 2s. 1d. per 1000 feet; 500,000 and under 1,000,000 feet, 1s. 11d.; 1,000,000 feet and upwards, 1s. 10d.; but the reduction in no case is retrospective.

The Recent Failure of the Electric Light in the City.—In the JOURNAL last week, we gave, from the *Electrical Review*, what purported to be an official explanation (it came from the Secretary of the City of London Electric Lighting Company) of the interruption of the incandescent lighting on the 9th inst. The version of the affair there given differed from that contained in the *Electrician;* but, as it bore the stamp of authority, it seemed to be reliable. It appears now that the reason given in the latter publication, as explained in our "Electric Lighting Memoranda," is the correct one; and the Editor of the *Review* is naturally annoyed at having been misled over the matter. He tells the Company that these accidents are becoming too frequent; and he urges them to look to their laurels, or they will find their customers returning to gas because it is more to be relied upon than the electric light.

Incandescent Gas Lighting.—A correspondent of the *Electrical Review*, writing on the subject of the remarks in that publication on the 12th inst. with regard to incandescent gas lighting, to which attention is directed in our editorial columns to-day, gives the following testimony to the value of that system: "After a trial of a single burner extending over five months, I have increased my installation by purchasing four more. The burner I have been using has replaced an Argand, with results which, without scientific analysis, have been eminently satisfactory so far as the atmosphere of the room is concerned; and this in the room in which I spend the greater part of my time when my day's work is done. That the lights do give, as is claimed for them, an illumination of 50 to 60 candles, with a consumption of 3½ or 4 cubic feet of gas per hour, I have on very excellent unbiassed authority—viz., a personal friend, who, as a principal owner in a suburban gas-works, devoutly hoped they would not come into very general use. In another room, one incandescent burner replaces three ordinary burners, and I have a better light than formerly. My first mantle lasted nearly five months, but was practically done about a fortnight before I replaced it. I do not care to speak positively as to the carbon monoxide said to be given off; but, looking at the construction of the burner, and the liberal supply of air given to it, I hardly believe any carbonic oxide could escape without being burnt; at all events, there has never been any appreciable odour of this gas, even after the burner has been lighted for hours. An enthusiastic admirer of the electric light whenever and wherever it can be obtained, I nevertheless believe in fair play to its small competitor, whose freedom from smoke makes it a great boon to those who, like myself, cannot procure the other."

Gas v. Electric Lighting in Sydney.—We gave, in the JOURNAL for the 9th inst. (p. 703), an abstract of the report of the Australian Gaslight Company for the half year ending June 30 last. In the course of the proceedings at the general meeting, a question was put to the Chairman as to the competition of the electric light with gas in Sydney. He replied that the proprietors had nothing to fear on this score, as the growth of both the day and night consumption of gas, and the low price charged for the public lamps, made the competition of electricity of small importance.

Mr. Joseph Chamberlain and the Birmingham Water Scheme.—Mr. G. Thonger, of Edgbaston, having sent to Mr. Joseph Chamberlain a plea for the re-opening of the question of the Welsh water scheme of the Birmingham Corporation, and a request for an interview on the subject, has received from the right hon. gentleman the following reply: "Dear Sir,—I am unable to see any reason why the Birmingham water scheme should not be as successful as those of Manchester and Liverpool. In order, however, to give an opinion of any weight, it would be necessary for me to make myself acquainted with every detail of this great undertaking. I have full confidence in the discretion of the City Council, and do not feel called upon to revise their judgment. Besides this, I imagine that large expenditure has already been incurred; and it would be too late now to make a change. I must, therefore, with many thanks, decline your request."

San Paulo Gas Company, Limited.—After making provision for depreciation and bad debts, the net profit of this Company for the six months ending June 30 last is £10,662. From this amount the interest on the debentures has been paid, and the sum of £2700 written off to exchange account; being the estimated loss caused by the depreciation in value of the currency balances, taken at 9⅛d., the rate of exchange at the date of the accounts. The balance added to that brought forward from the previous half year—viz., £2564—makes a total of £9682 to the credit of the profit and loss account. Out of this sum a dividend will be paid at the rate of 6 per cent. per annum, free of income-tax, absorbing £7500; and the balance of £2182 will be carried forward. The revenue receipts and expenditure have been converted at 9⅜d.,—the average rate of exchange ruling during the six months. The number of public lamps on June 30 last was 2048; and the meters in private use, 5250. The quantity of gas consumed shows an increase of 22 per cent. over that for the first half of 1893.

Ceara Gas Company, Limited.—The Directors of this Company report that the increased revenue for the year ending June 30 last is very gratifying, and, but for the exchange, would have resulted in additional profit. In consequence, however, of the depreciation of the purchasing power of the milreis, the working expenses in Ceará are considerably higher, in addition to which the exchange is £850 more than in 1893. There was an extra expenditure on coal of £523, which is explained by the larger receipts for gas and residual products. The result of the year's working is a profit of £3665, which, under the circumstances, may be considered satisfactory. This amount, added to the balance brought forward (£526), gives a total of £4191. Deducting the £1614 paid as interim dividend, there remains £2577 available for division. The Directors recommend the payment of dividends for the six months ending June 30 last of 5 per cent. on the preference shares (less income-tax), and of 4 per cent. on the ordinary shares (tax free). These will absorb £1911, and make 10 and 7 per cent. for the year.

The New Water-Works at Swansea.—The formal opening of the Upper Lliw reservoir of the Swansea Corporation was performed last Friday week. The reservoir has been completed nearly two years; and it has been used first of all as a storeage, and later as an ordinary source of supply, with considerable success. But the ceremony of inaugurating it was deferred, pending the settlement of the heavy litigation with the Contractors (Messrs. Baldry and Yerburg). This, as already announced in these columns, has happily been brought to a satisfactory issue. The party present at the opening consisted of the Mayor (Lieut.-Col. Pike) and members of the Corporation, with the officials. The Chairman of the Water Committee (Alderman Martin), in asking the Mayor to open the valve-house and turn on the water, gracefully acknowledged the indebtedness of the Corporation to the Contractors for the excellent work they had given to the town. His Worship (who was presented with a handsome key as a momento of the occasion) then opened the valve-house and pulled the levers by which water was sent into the town mains.

Liverpool Corporation Water Affairs.—In replying to a vote of thanks which was passed to him by his colleagues on the Liverpool Corporation Water Committee at their final meeting for the present municipal year last Tuesday, Alderman T. Hughes, the Chairman, said he never remembered a time when the Committee's work had been carried on so smoothly as within the past twelve months. He was glad to think that, notwithstanding the great cost of the new works, which during the coming year would have to be fully met, inasmuch as the new sinking fund would then come into operation, they could look forward with confidence to the future. The revenue was increasing; and they would be able to meet their further obligations without placing any increased rate upon any portion of the community. This year they had delivered 7576 million gallons of water—an increase of 40 million gallons upon the previous year, although then there were extraordinary demands made upon them in consequence of the dry weather. This was the result of having taken upon their books a large number of new customers. They had made good arrangements with several communities outside the compulsory area to take water in bulk, which meant, of course, increased revenue. This year the revenue would be about £7000 or £8000 in excess of last year. Then they had crowned the year with practically carrying out the necessary adjunct to the water-works at Vyrnwy—the bringing in to the city of the water by the new main from Prescot. A new main had been laid at the south end of the city, which had given great satisfaction. A similar course would be adopted at the north end, where there had been complaints about the pressure being insufficient. When all their arrangements had been completed, the delivery of water would be most satisfactory. In conclusion, the Chairman paid a compliment to the Water Engineer (Mr. J. Parry) for the valuable assistance he had rendered the Committee during the year.

Sale of Shares.—Last Tuesday, Messrs. J. and A. Bray, of Hastings, disposed of £25 shares in the *Hastings and St. Leonards Gas Company* at £65 each, and £20 shares at £41 and £40 5s.

Embezzlement from the Birmingham Corporation Water Department.—John Daniel Ball, who had been arrested on a warrant charging him with having stolen the sum of £10 6s., the money of the Water Department of the Birmingham Corporation, was brought up before the City Stipendiary yesterday week. Prisoner had been employed in the responsible position of counter cashier in the offices of the department for about twelve years. On Jan. 6 last, his accounts were found to be irregular; and the sum mentioned in the charge was discovered to be unaccounted for. A warrant was obtained for his arrest; but he absconded, and did not return to Birmingham—as far as the police can ascertain—until a few days before he was taken up. An examination in the meantime of the books kept by the prisoner has disclosed the fact that the £10 6s. is not the only amount unaccounted for. It is alleged that he has defrauded the department to the extent altogether of about £300. The prosecution applied for a remand, in order to give them time to prepare their case, which, it was said, might prove of a complicated nature; and it was granted. Prisoner was brought up again last Friday, and pleaded "guilty." He was sentenced to six months' imprisonment, with hard labour.

Leeds Corporation Gas Affairs.—At last Thursday's meeting of the Leeds Corporation Gas Committee, a few matters of general interest occupied attention. It was reported that the new gasholder at Dewsbury Road had been completed, and was ready for use, and that 20,000 tons of water had been required to fill the tank. The question of quarterly gas accounts was considered; and Mr. Derry, the City Accountant, submitted an elaborate report on the subject, with a comparison as between Leeds, with six months' accounts, and Manchester and Birmingham, with three months' accounts. It was agreed that the report should be added to the minutes and printed and circulated. Mr. Everett tendered his resignation as Chemist to the Gas Committee on his appointment as Engineer to the Ilkley Gas Company. It was stated that this was the third instance during the last three years in which a member of the staff employed by the Gas Committee had obtained a position as gas engineer in another town, and that this was due, in great measure, to the system of promotion which the Committee had adopted, and which, by giving their employees an insight into various departments of gas manufacture, prepared them for responsible positions, either under the Committee or elsewhere. Mr. Everett entered the service of the Corporation as a boy at the New Wortley works.

The Financial Affairs of Salford.—At a meeting of the Salford Town Council last Wednesday, Mr. Desquesnes called the attention of the Mayor (Sir W. H. Bailey) to certain letters and articles which had appeared in various newspapers, alleging the disappearance of £70,000 (see *ante*, pp. 688, 703), the inability of the Corporation to account for the same, and the existence of a conspiracy of silence in regard to the matter, and asked whether, pending the issue of the report of the Special Committee that had been appointed, the Mayor was prepared to make a statement on the subject. The Mayor replied that there had been no money lost at all; the Corporation having really only overdrawn their bankers. They had spent more money in public improvements than the rate provided them with, which was not an unusual thing for a Corporation to do; and a Committee had been appointed to see what surplus balances they had in connection with the Corporation funds, in order that, with the aid of these, they might adjust their banking account. There was no occasion for any public excitement; and he thought that those papers that had so grievously misunderstood the position of affairs ought to give equal publicity to his flat contradiction of the untruthful description that had been given of the financial position of the borough. He also denied the allegation that there had been a conspiracy of silence.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 774.)

Issue.	Share	When ex-Dividend.	Dividend or Div. & Bonus.	NAME.	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	11 Oct.	10½	Alliance & Dublin 10 p. c.	10	19–20*	+½	5 5 0
100,000	10	,,	7½	Do. 7 p. c.	10	13–14*	+½	5 7 2
300,000	100	2 July	5	Australian (Sydney) 5 % Deb.	100	105–107	..	4 13 4
100,000	20	14 June	8	Bahia, Limited	20	11–13	..	12 6 2
200,000	5	11 May	6½	Bombay, Limited	5	6½–6⅝	..	4 16 5
40,000	5	,,	6½	Do. New	5	4⅞–4¾	..	5 9 6
380,000	Stck.	15 Aug.	11½	Brentford Consolidated	100	227–232	+5	4 19 1
180,000	,,	,,	8½	Do. New	100	177–182	+2	4 13 4
220,000	Stck.	28 Sept.	11	Brighton & Hove Original	100	210–215	+2	5 2 4
888,500	Stck.	30 Aug.	5	Bristol	100	115–120	+2	4 3 4
320,000	20	28 Sept.	11½	British	20	48½–49½	+½	4 10 10
50,000	10	30 Aug.	11½	Bromley, Ordinary 10 p. c.	10	19–22⅝	..	5 2 2
51,510	10	,,	8½	Do. 7 p. c.	10	16½–17½	..	4 17 2
328,750	10	28 June	2	Buenos Ayres (New) Limited	10	7–7⅛	–¼	2 13 4
200,000	100	2 July	6	Do. 6 p. c. Deb.	100	101–104	..	5 15 5
150,000	20	12 July	8	Cagliari, Limited	20	25¼–26½	..	6 0 8
550,000	Stck.	11 Oct.	13	Commercial, Old Stock	100	267–272*	+2	4 15 7
165,000	,,	,,	10	Do. New do.	100	195–20.*	..	5 0 0
160,762	,,	14 June	4½	Do. 4½ p. c. Deb. do.	100	132–137	..	3 5 8
800,000	Stck.	14 June	13	Continental Union Limited	100	242–247	+2	5 5 3
200,000	,,	,,	10	Do. 7 p. c. Pref	100	210–215	..	4 13 0
533,000	Stck	30 Aug.	5	Crystal Palace Ord. 5 p.c. Stk	100	112–117	+4	4 5 6
486,090	10	27 July	11	European, Limited	10	22½–23½	..	4 13 7
354,060	10	,,	11	Do. Partly paid	7½	16–17	..	4 17 1
5,646,590	Stck	15 Aug.	12	Gaslight & Coke, A, Ordinary	100	248–252	..	4 15 3
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	100–104	..	3 16 11
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	277–282	..	3 10 10
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	130–135	..	3 14 1
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	200–205	..	3 13 2
1,300,000	,,	,,	7	Do. H, 7 p. c. max	100	180–18:	..	3 15 8
1 63,000	,,	,,	10	Do. J, 10 p. c. Prf.	100	272–277	..	3 12 3
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	100	165–170	..	3 10 7
1,061,150	,,	14 June	4	Do. 4 p. c. Deb. Stk.	100	127–130	..	3 1 6
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	132–137	..	3 5 8
908,000	,,	,,	6	Do. 6 p. c. do	100	177–182	..	3 6 0
3,800,000	Stck.	11 May	12	Imperial Continental	100	228–233	..	5 3 0
75,000	5	14 June	6	Malta & Mediterranean, Ltd.	5	5–5⅛	..	5 9 1
560,000	100	1 Oct.	5	Met. of Melbourne, 5 p. c. Deb.	100	109–111	..	4 10 1
541,920	20	14 June	5	Monte Video, Limited	20	15–16	..	5 5 0
150,000	5	30 May	8	Oriental, Limited	5	6¾–7⅛	–⅛	5 10 4
60,000	5	13 Sept.	7	Ottoman, Limited	5	4–4⅛	..	7 15 6
166,870	10	31 Jan.	2	Para Limited	10	1¾–2¼	..	3 17 9
420,000	100	2 May		People's Gas of Chicago—1st Mtg. Bds.	100	104–108	..	5 11 1
500,000	100	1 June	6	and Do.	100	98–103	..	5 16 6
150,000	10	11 Oct.	6	San Paulo, Limited	10	9–9½*	..	6 6 4
500,000	Stck.	30 Aug.	15½	South Metropolitan, A Stock	100	331–336	+1	4 12 3
1,350,000	,,	,,	12	Do. B do.	100	277–282	..	4 5 1
260,000	,,	,,	[3	Do. C do.	100	287–292	..	4 9 0
750,000	,,	12 July	5	Do. 5 p. c. Deb. Stk.	100	156–161	..	3 2 2
60,000	Stck.	30 Aug.	11½	Tottenham & Edm'nton, "A"	100	215–220	..	5 4 7
				WATER COMPANIES.				
746,011	Stck.	28 June	10	Chelsea, Ordinary	100	288–293	+3	3 8 3
1,719,514	Stck.	11 Oct.	8	East London, Ordinary	100	230–235*	..	3 8 1
654,740	,,	28 June	4½	Do. 4½ p. c. Deb. Stk.	100	147–152	..	2 19 2
700,000	50	14 June	8½	Grand Junction	50	120–124	..	3 8 7
708,000	Stck.	15 Aug.	12	Kent	100	302–307	..	3 18 2
1,043,800	100	28 June	9½	Lambeth, 10 p. c. max.	100	267–272	+2	3 9 10
406,200	100	,,	7½	Do. 7½ p. c. max.	100	209–214	+2	3 10 1
330,000	Stck.	28 Sept.	4	Do. 4 p. c. Deb. Stk.	100	132–135	..	2 19 3
500,000	100	15 Aug.	12½	New River, New Shares	100	382–387	..	3 2 8
1,000,000	Stck.	27 July	4	Do. 4 p. c. Deb. Stk	100	134–137	..	2 18 4
902,300	Stck.	14 June	6	S'thwk & V'xhall, 10 p. c. max.	100	168–173	..	3 9 4
126,500	100	,,	6	Do. D 7½ p. c. do.	100	150–155	..	3 17 5
1,155,066	Stck.	14 June	10	West Middlesex	100	275–280	+2	3 11 5

*Ex div.

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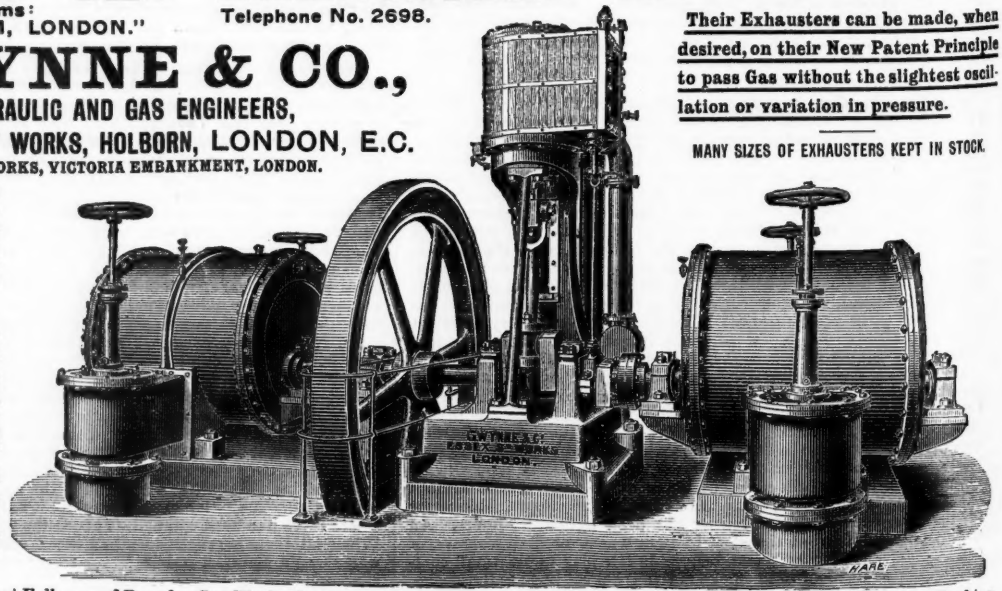

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Orders for Alterations in, or Stoppages of PERMANENT ADVERTISEMENTS should be received not later than the FIRST POST on SATURDAY.

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Telegrams: "HUTCHINSON BROS., BARNSLEY."

REDHILL GAS-WORKS ASSESSMENT APPEAL.

THE Report of the proceedings at the hearing of the APPEAL of the REDHILL GAS COMPANY against the RATING OF THEIR PROPERTY in Reigate and Nutfield which was published in the JOURNAL has been reprinted (by desire) in Pamphlet form; and copies can be obtained, on application to the PUBLISHER, *price 4d. each.*

NOTICE OF ACCIDENTS ACT, 1894.

A CARD suitable for Exhibiting in Gas- Works, directing Officers and Workmen to REPORT to the Manager or Deputy-Manager all ACCIDENTS witnessed by them, together with the Clause of the Act specifying the notice required to be sent to the Board of Trade, has been prepared in compliance with a suggestion; and copies can be obtained, on application to the PUBLISHER of the JOURNAL, *price 4d. each, or 2s. 6d. per dozen, post free.*

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TAR CONTRACT.

THE Aldershot Gas and Water Company are prepared to receive TENDERS for the surplus TAR produced at their Gas-Works from the 1st of January to the 31st of December, 1895.
Coal consumed, about 7000 tons.
Tenders, marked "Tar," to be addressed to the Secretary, Gas and Water Company, Victoria Road, Aldershot, on or before the 13th of November prox.

FIRE-CLAY GOODS.

THE Directors of the Sheffield United Gaslight Company invite TENDERS for the supply of FIRE-CLAY GOODS (Retorts, Bricks, &c.) required for Repairs at their Neepsend and Effingham Street Stations during the next Twelve Months.
Specifications and Forms of Tender may be had on application to the Company's Engineer, Mr. Fletcher W. Stevenson.
The Directors do not bind themselves to accept the lowest or any tender.
Sealed tenders, marked "Tender for Fire-Clay Goods," must be delivered by post, addressed to the undersigned, not later than Saturday, Nov. 3 next.
HANBURY THOMAS,
General Manager
Commercial Street, Sheffield,
Oct. 13, 1894.

PONTYPRIDD LOCAL BOARD (GAS).

CONTRACT NO. 3.

THE Pontypridd Local Board invite TENDERS from experienced Builders for the construction of a RETORT-HOUSE and COAL-STORE, TAR-TANK, BOILER and ENGINE HOUSE, PURIFYING and METER HOUSES, OFFICES, ENTRANCE GATES, RETAINING and BUTTRESS WALLS, and FOUNDATIONS to PILLARS of RAILWAY SIDING, on the Premises of the Local Board at Gwern-y-Gerwn, Treforest, near Pontypridd.
The Specification and Drawings may be seen on application to the undersigned, and at the Office of Mr. Thomas Newbigging, C.E., 5, Norfolk Street, Manchester. Quantities and Forms of Tender may be obtained from the latter on deposit of Three Guineas, which will be returned on a *bonâ-fide* tender being received.
Tenders, endorsed "Gas-Works Contract No. 3," to be sent so as to reach me before Noon on Tuesday, the 13th day of November, 1894.
The Board do not bind themselves to accept the lowest or any tender.
By order,
HENRY LL. GROVER,
Clerk.
Local Board Gas Offices, Pontypridd,
Oct. 17, 1894.

Price 2s. per dozen, or 10s. 6d. per 100, post free.

CONSPIRACY and Protection of Pro- perty Act. It is required, under a Penalty of FIVE POUNDS, that a Printed Copy of the 4th Section of this Act shall be posted up at all Gas-Works, in a conspicuous place, where the same may be conveniently read by the persons employed thereat.
Printed copies of this Section, in large type, on broad sheets, may be obtained of WALTER KING, 11, Bolt Court, FLEET STREET, E.C.
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The *Chemical Trade Journal* says: "Neatly and strongly bound, this little work forms a most useful and handy guide to the management of gaseous fuel furnaces."
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ANALYSIS OF THE ACCOUNTS
OF THE
Metropolitan Water Companies,

Chelsea, East London, Grand Junction, Kent, Lambeth, New River, Southwark and Vauxhall, and West Middlesex—showing the Capital, Income, Expenditure, Profits, and Dividends per Million and per Thousand Gallons of Water supplied; the proportion of Expenditure and Profits to Gross Income; and the Income, Expenditure, and Profits per House, &c., supplied for the Year ended December 31, 1893, or March 31, 1894, together with the quantity of Water supplied, the estimated daily quantity supplied for domestic and other purposes, the quantity supplied per head of population, &c., &c., for the Year ended December 31, 1893.

Compiled and arranged by
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By
NORTON H. HUMPHRYS, Assoc. M.Inst.C.E., F.C.S.

This work contains chapters on: The Relative Cost of Light from Gas, Oil, and Candles; Products of Combustion; The Sulphur Question; The Composition of Illuminating Gas; Water Gas; Various Gas-Making Processes; Oil Gas; Properties of Fluid Hydrocarbons; Tar for Gas-Making; Destructive Distillation; Condensation; and Purification.

London:
WALTER KING, 11, Bolt Court, Fleet Street, E.C.

MICHAEL AND WILL ON GAS AND WATER.
This Day is published in One Vol., Royal 8vo., 32s. Cloth.
The Law of Gas, Water, & Electric Lighting.
Fourth Edition.
Re-written and brought down to date,
By J. SHIRESS WILL, Q.C.
London: Butterworths, 7, Fleet Street (Her Majesty's Law Publishers).

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Worked by THE HARTON COAL CO., LTD.
Output about 3000 tons per day.

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Yield of Gas per ton	10,500	Cubic Feet.
Illuminating Power	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
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OUT OF THEIR
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Tudhoe Gas-Works,
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The Coke was of excellent quality.
The following is a complete ultimate Analysis of the Coal.

	Per Cent.
Carbon	83·128
Hydrogen	5·116
Oxygen	7·401
Nitrogen	0·585
Sulphur	0·620
Ash	3·130
Water	0·020
	100·000

Analysis of the Coke.

Carbon	93·31
Sulphur	0·61
Ash	5·00
Moisture	1·08
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I am, Gentlemen,
Yours truly,
A. B. Cowan,
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Coke . . . . . 68 per cent.
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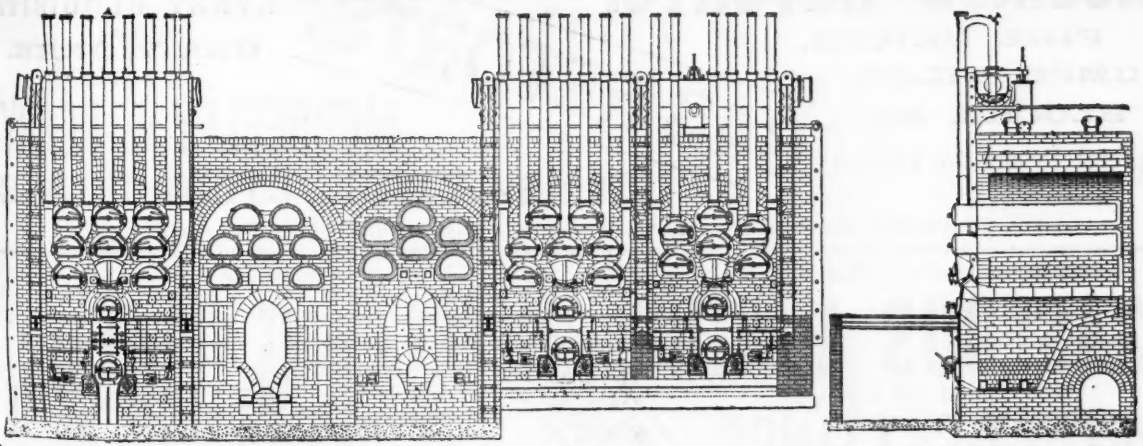
HISLOP'S PATENT REGENERATIVE SETTINGS OF GAS-RETORTS.



THESE SETTINGS ARE POSITIVELY UNRIVALLED IN PRODUCTIVE CAPACITY, DURABILITY AND SIMPLICITY OF MANAGEMENT. RETORTS OF ORDINARY DIMENSIONS, CARBONIZING FROM 18 TO 24 CWT. OF ENGLISH AND 21 TO 26 CWT. OF SCOTCH COAL PER 24 HOURS, DEPENDING UPON THE NATURE OF THE COAL, AND PRODUCING UP TO FULLY 13,000 CUBIC FEET PER MOUTHPIECE IN THE SAME TIME, AND WITH THE SMALLEST EXPENDITURE OF FUEL ATTAINABLE, AND RETURNING IN PROFIT THE ENTIRE COST OF ERECTION WITHIN TWELVE TO EIGHTEEN MONTHS, AND THUS REDUCING TO INSIGNIFICANCE THE INCREASED COST OF THESE SETTINGS OVER THE COMMON OR GENERATOR FURNACE SYSTEMS.

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Further particulars may be obtained on application to the Patentee's Agents: C. M. HAMILTON, 5, Stuart Street, Shawlands, Glasgow; J. E. FISHER, Stourbridge; JOHN WALSH & SONS, Retort Builders, Halifax, Yorkshire; RICHARD TURNER, Retort Builder, Denton, Lancashire; and from the Principal Agent, R. F. HISLOP (son of Patentee), Gas-Works, Paisley, N.B.

HISLOP'S PATENT HYDRAULIC MAIN SEAL-REGULATING AND TAR-EXTRACTING VALVE is a *Sine quâ non* TO THE SATISFACTORY WORKING OF THE HYDRAULIC MAIN UNDER THE REGENERATIVE AS WELL AS OTHER SYSTEMS OF RETORTS. BEING LARGELY ADOPTED AND AFFORDING THE HIGHEST SATISFACTION.

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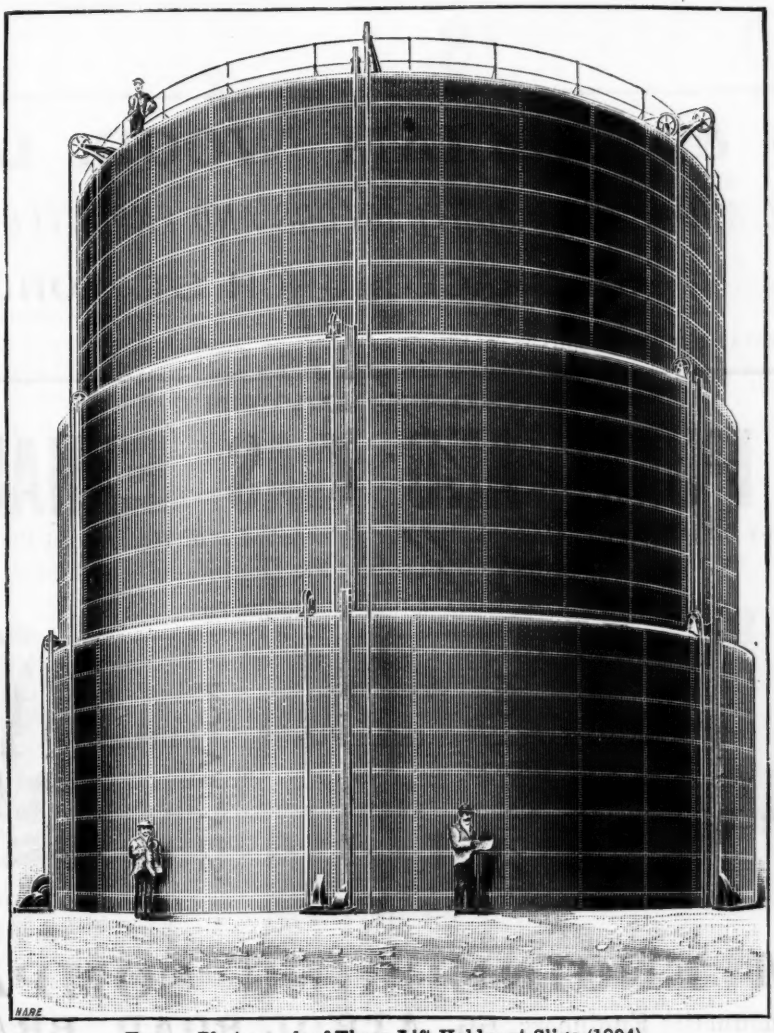

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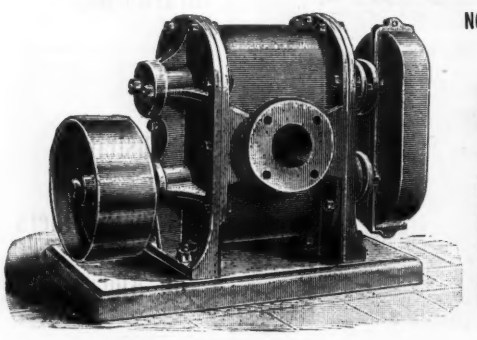

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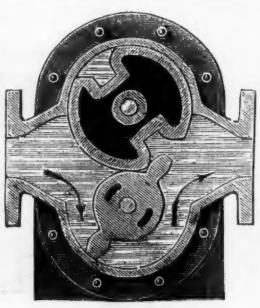

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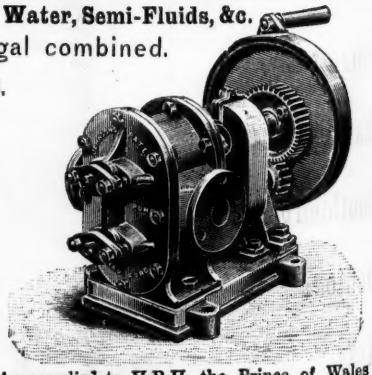

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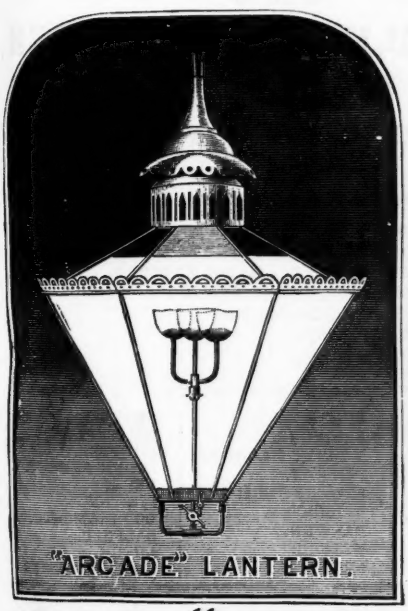

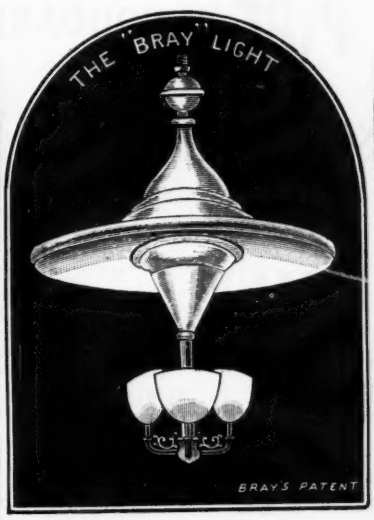

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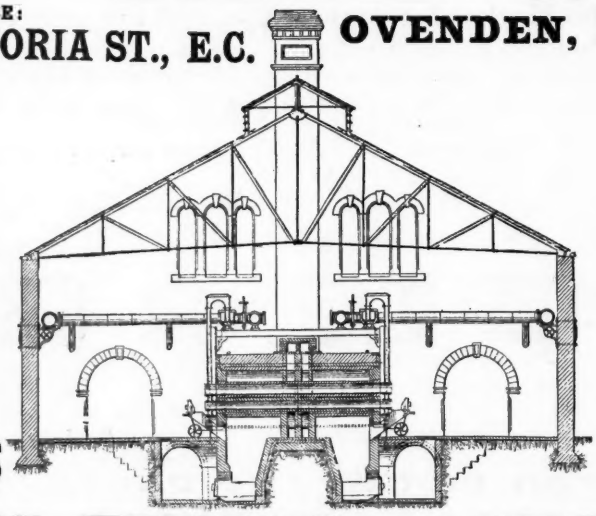

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LIGHT for LIGHT
less than half the price of any other Regenerative Lamp.
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